BULLETIN OF THE SCHOOL OF EDUCATION INDIANA UNIVERSITY

Vol. XVI November, 1940 No. 6

Bureau of Cooperative Research
School of Education
Indiana University, Bloomington, Indiana

HENRY LESTER SMITH, Director
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Price, 50 cents

For sale by the University Bookstore,
Bloomington, Indiana

This bulletin is indexed by title in the following:
Bibliographic Index

The current literature section of the

Loyola Educational Digest

Wilson Education Index

Entered as second-class mail matter September 30, 1924, at the post office at Bloomington, Indiana, under the Act of August 24, 1912. Published in January, March, May, July, September, and November of each year from the University Office, Bloomington, Indiana.

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BULLETIN OF THE SCHOOL OF EDUCATION
INDIANA UNIVERSITY

The Teaching of Arithmetic to Low-Ability Students in the Elementary Schools

by

HENRY LESTER SMITH
and
MERRILL T. EATON

A List of Bulletins in the Field of Education, Indiana University

by

KATHLEEN DUGDALE

Published by the
BUREAU OF COOPERATIVE RESEARCH
Indiana University

PREFACE

In this bulletin an attempt has been made to summarize the literature dealing with the many problems encountered in the teaching of arithmetic to low-ability pupils in the elementary school.

The great diversity of opinion concerning the content, organization, and methods of teaching to be used in teaching arithmetic to the low-ability student has stimulated a formidable amount of research. It is hoped that this summarization of the researches on the various phases of the subject will assist school administrators and teachers in organizing a more effective and more practical program in arithmetic for the low-ability pupil.

The authors of this bulletin are under special obligation to Mr. Michael Kowan, assistant, School of Education, who helped in reading and summarizing the materials, and to Miss Kathleen Dugdale, who assisted in editing the manuscript.

H. L. S.
M. T. E.

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The Teaching of Arithmetic to Low-Ability Students in the Elementary Schools

By Henry Lester Smith and Merrill T. Eaton

CHAPTER I

DEFINITION OF THE LOW-ABILITY STUDENT

The Legend of Innate Ability for and Difficulty of Mathematics

"That dull subject, mathematics,"[1] as Trustram (611)[2] puts it, has long been the big, bad wolf of the elementary curriculum, putting an unwarranted fear in the hearts of students from the very beginning of their formal schooling. The tradition of the inherent difficulty of all number work has become an accepted concept, despite such studies as that of Washburne and Vogel (653), which show how few and remediable are the actual difficulties in this subject-matter area if it is taught with an eye to individual failings and on the basis of known general sources of error. The legend has grown among children as the result of the reputation for "toughness" attributed to mathematics by fellow-students as well as by parents who sympathizingly recall the days when they, too, were plagued by the same old demon. Writers on the subject, such as Johnson (315), Mallory (397), Rogers (535), and Schorling (557), realize the need to break down this barrier by fostering the growth of home-school coöperation which will educate parents to the new objectives and methodologies in the teaching of mathematics. It is, of course, needless to say that this fostering of a new outlook on mathematics would be completely futile without a compensatingly drastic revision in the actual teaching of number work. Indicative of the barrage of disconcerted efforts at "drastic change" are such reports of attempts at curriculum revision as that of Johnson (312), and such efforts as the psychological approach outlined in books like that of Wheat (663) and in short papers like that of Smith (563).

If the so-called "normal" student finds himself worried at the prospect of studying mathematics, how much more acute and distressing must the situation be for the so-called "low-ability" student who, as Schorling (557) notes, usually faces the rigors of number work with dread. The problem of considering to what extent retardation of low-ability students in mathematics is directly attributable to this fear arises at once.

[1] We have used the terms "arithmetic" and "mathematics" interchangeably throughout this paper, since they are so used throughout the literature reported upon. We agree, however, with Sueltz (592), who thinks the term "mathematics" for the elementary school may well be substituted for "arithmetic" because of the generally narrow connotation attached to the latter term.

[2] Numbers refer to references listed in the bibliography, pages 98 to 123.

The Need for Definition of "Low Ability"

The literature written concerning low-ability and atypical children points out various classifications of these cases as determined by the cause of their deficiencies.

Low mentality as a factor.—By far the most generally accepted classification of low ability is in terms of mental ability on the basis of I.Q.'s determined by such generally accepted tests as the Binet-Stanford. Such writers as Wallin (635) set up an I.Q. of 65 to 80 for "borderline" and "backward" children, while Baker (29) brands those falling within the I.Q. range of 70 to 90 as "dull." "Borderline" for Anderson (12) includes I.Q.'s between 70 and 85, with "subnormals" caged in between 50 and 70 and those with I.Q.'s below 50 noted as "institution cases." Still others like Ingram (299) and Kennedy-Fraser (333) relegate as "permanently backward" or "mentally retarded" students falling within the I.Q. ranges of 50 to 75 and 50 to 80 respectively.

Anderson (11) translates I.Q. in terms of years retarded in the work of the school, with the "backward" retarded two years, and the "defectives" retarded three years or more. This type of classification is outmoded with the growing realization that actual retardation in the school may have nothing to do with a student's ability to learn, but all too frequently is an indication of the failure of the curriculum and the methodology of the teaching personnel to adapt itself to the abilities, interests, and immediate and potential needs of the individual student, as has been repeatedly noted by such writers as Woodrow (691).[3]

This entire matter of establishing standardized, objectively-determined categories setting forth the I.Q. ranges for normal, borderline, and subnormal mental-ability groups on the basis of the best tests available is one needing a great deal more research and clarification. We do not mean to suggest, however, that, once such standards are set up, they shall become absolute in relegating students to certain rigid curricula according to their established ability to achieve, nor that these standards will ever be so perfected as to become a *sine qua non* of educational procedure. Doll's (185) statement to the effect that diagnosis of borderline mental cases on the basis of intelligence alone is almost impossible and that I.Q.'s must never be considered as sole determinants is still largely supported by such more recent studies as that of Bieth (58).

For the purposes of this paper, however, it is mainly of importance to note the universal stress on low mental ability as a characteristic of the low-ability student and to consider this factor in the discussion of methodology in the teaching of mathematics to such students. It is well to note the many studies, experiments, and philosophical statements which agree on this point.[4] To this list may be added those which stress the use of intelligence tests as a basic procedure in the determina-

[3] p. 140.

[4] These studies include, aside from those already mentioned, the following references in the bibliography: 2, 20, 30, 31, 48, 56, 60, 71, 84, 105, 106, 110, 112, 126, 127, 172, 179, 196, 208, 210, 212, 213, 217, 220, 250, 271, 290, 323, 355, 360, 362, 382, 389, 471, 526, 536, 550, 557, 573, 595, 605, 613, 618, 632, 633, 638, 650, 662, 666, 694, 696, 706.

tion of curriculum and methodology, discussed later in this survey. The universal agreement on the factor of low mentality as perhaps the major characteristic of the low-ability student further emphasizes the necessity for more research on the matter of setting up scientifically determined categories and criteria for these classifications as a beginning step in the solution of the educational problem of the low-mentality student.

Among the numerous characteristics of the low-ability student relevant to this generally agreed-upon lack of mental ability, some of the most important ones, educationally, seem to be the following:

1. The lack of ability to see relationships and to reason and form generalizations and judgments is stressed by many writers.[5] There is also the long list of writers cited later in this paper who prescribe definite methodologies for helping to remedy these failings.
2. The lack of imagination, initiative, independence, and resourcefulness is brought out by other writers.[6] Again, added to these, we may consider the writers noted in the later sections of this survey who set forth specific remedial procedures for these shortcomings.
3. The short attention span of the low-ability student, coupled with his slow learning and quick forgetting, is stressed by still other writers.[7] To these should be added the proponents of various methods to improve memory, to apportion units of work in keeping with the abilities of individual students, and to use similar teaching and administrative devices to remedy the aforementioned failings.

Emotional maladjustment as a factor.—A second universally recognized and discussed characteristic of the low-ability student is what may be generally called his "emotional" maladjustment. This is closely allied with what many writers refer to as his "social" maladjustment, which is discussed in the next few pages. It is very difficult to determine where emotional maladjustment leaves off and social maladjustment begins, and perhaps impossible to separate the two in their inextricable causative relationships one to the other. In an effort to be definitive, we may note that emotional maladjustment, as we have found it referred to in the literature, is generally indicated by such observable behavior as self-consciousness, egocentric thinking, hypersensitivity, fearfulness and timidity, inferiority complex, moodiness, day-dreaming, various neuroticisms, motor restlessness, nostalgia, fear of ridicule and condemnation, pathological lying, and similar symptoms.[8]

It is obvious how many of these symptoms ascribed to low-ability students by writers on the subject pertain also to exceptionally brilliant children and to all too many normal children under duress from various

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[5] See references 31, 32, 52, 55, 86, 105, 110, 126, 127, 136, 137, 204, 208, 299, 309, 333, 389, 471, 550, 583, 595, 634, 642, 691, 692, 694, 703.

[6] See references 32, 71, 105, 110, 137, 208, 299, 332, 355, 389, 461, 526, 550, 613, 634, 694.

[7] See references 34, 55, 62, 71, 105, 110, 137, 159, 163, 182, 189, 204, 208, 250, 340, 344, 355, 389, 432, 433, 441, 471, 482, 491, 550, 557, 585, 634, 669, 691, 694, 703.

[8] These have been pointed out and commented upon in such references as 2, 4, 21, 30, 32, 58, 105, 106, 110, 126, 127, 154, 155, 185, 186, 208, 211, 220, 308, 311, 312, 315, 319, 382, 389, 479, 526, 535, 546, 550, 587, 595, 605, 623, 634, 665, 694, 696.

pressures. A great deal of additional research is necessary to determine more accurately the relationships between emotional and social maladjustment in pupils. The stress on emotional maladjustment is almost universal in the discussions of low-ability groups, especially of those who are dubbed "problem" children. This will be noted in the later survey of the numerous writers who advocate mental hygiene programs, and in the establishment of psychiatrical clinics either within the school or adjacent and available to it.

Social maladjustment as a factor.—In noting the many traits in social maladjustment that are parallel to those attributed to emotional maladjustment in the low-ability group, writers point out such behavior as antagonism to authority, moral weaknesses, truancy, failure to coöperate with teachers, failure to join fellows in leisure activities, failure to accept responsibilities, inability in leadership, intolerance of the opinions of others, and general discourtesy. Such behavior has been largely attributed to the fact that in a great number of cases low-ability students come from the poorest home environments and from slum communities.[9] Many writers recognize this type of social maladjustment in their advocacy of a school program for the low-ability student which will stress the immediate and future social needs of the students involved and do whatever is possible to minimize and negate the detrimental effects of poor environment upon social conduct.[10]

Physical handicaps as a factor.—As Bieth (58) and others have noted, the factor of the various physical disabilities which handicap so many students in the low-ability group further complicates the problem. Undoubtedly contributing both to social as well as to emotional maladjustment, these physical disadvantages play a dominant role in the general educational retardation of low-ability students. No *one* of the classifications discussed below, with the possible exception of hereditary feeble-mindedness or other mental disabilities, is exclusive of the others, and all of these are integrally and inextricably related to and retroactive upon one another.

Many authorities[11] have pointed out and commented upon both the permanent and the remediable physical disabilities. These deficiencies may be due to heredity, accident, or environment, and may include the following: loss of the senses, such as total or partial blindness, deafness, and dumbness; aphasia, aprosexia, apraxia, and kindred defects; and generally poor physical condition as evidenced by such symptoms as excessive fatigue, restless sleep, digestive difficulties, irregular breathing, malnutrition, underweight or overweight condition, bad teeth, enlarged tonsils, slowness and ineffectuality in participation in games, and chronic minor ailments such as recurrent susceptibility to colds.

[9] See references 30, 31, 48, 58, 71, 105, 106, 208, 250, 526, 595, 605, 618, 632, 633.

[10] See references 32, 46, 53, 55, 72, 81, 110, 111, 117, 130, 135, 140, 162, 163, 177, 185, 190, 214, 220, 222, 236, 238, 254, 255, 271, 299, 300, 312, 320, 333, 362, 373, 389, 396, 397, 404, 416, 419, 475, 479, 486, 490, 515, 538, 565, 583, 594, 634, 650, 656, 657, 664, 668, 680, 690, 694, 696.

[11] See references 2, 31, 32, 48, 50, 58, 106, 126, 127, 146, 208, 250, 300, 302, 323, 362, 432, 471, 500, 532, 533, 536, 550, 554, 602, 605, 613, 632, 633, 634, 691, 694, 704.

Educational retardation as a factor.—Finally, among the widely-noted failings of the low-ability student, is his general educational retardation, or, as is noted by numerous authorities including Bentley (48),[12] Burt (127),[13] and Groszmann (250),[14] his partial educational retardation as evidenced by normal progress in certain subjects and below-average progress in certain other subjects. This phenomenon of partial retardation is attested to by the writers[15] on the subject who advocate special opportunity classes or coaching arrangements in homogeneous groups, but who stress the need for the return of pupils to the normal classes as soon as they are able to carry on their work with the regular classroom routine. Partial retardation presents a problem to educators, in the light of such beliefs as those of certain anthropologists and psychologists who insist that traits or inherent abilities for success in certain fields of endeavor are neither innate nor hereditary but are almost entirely the product of the formative forces of environment. These points of view are also entertained by educators such as Adler (3), Allen (4), Beke (44), Burt (127), Dexter (180), Monroe (427), Washburne and Vogel (653), and Wenzl (659), who tend to break down the theory of the inherent difficulty of mathematics and the need for some special ability to achieve success in that area. The problem becomes more painfully acute when one is forced to admit, as has already been noted, that mathematics is, perhaps, the single field in which the largest number of students suffer partial retardation and failure. Innumerable studies have attempted to find the reasons for this phenomenon, and nearly all of them imply, directly or indirectly, agreement with this lamentable state of affairs in their proposals for methodologies to remedy these failings.

The consensus among present-day writers on the subject seems to be summed up by Woodrow[16] when he notes that "the point to be kept in mind is that the failing child is not receiving the right kind of attention . . . a child's failure to pass is merely a failure on the part of the educational procedure used to produce the expected result." The endless listings that could be made of writers stressing individualized programs in keeping with the abilities, interests, and needs of the student, and the need for a more flexible and constructive system of grading and promotion all lend support to Woodrow's caustic indictment.

Otto (478) states that, if the doctrine of adapting schools to individual differences were accepted, then, theoretically at least, pupil failure would become a myth. If students are carefully studied, if adequate diagnoses are made, and if methods and materials are properly adapted, it is to be assumed that practically all children will achieve according to their ability. No one can legitimately expect greater achievement. If the assumption is valid, then there is no excuse for failure.

Such a study as Kyte's (355), which reveals that the largest proportion of non-promoted pupils in a first-grade class examined were

[12] pp. 5-6.

[13] pp. 459-60, 607 ff.

[14] pp. 482-3.

[15] See references 26, 158, 341, 377, 435, 476, 635, 657, 664, 706.

[16] Woodrow, H. H. *Brightness and Dullness in Children.* J. B. Lippincott Co., Philadelphia, 1919. p. 140.

children possessing average intelligence, makes it imperative to find out why so many normal children fail to make progress generally throughout their school work, or fall down in specific areas of the curriculum. Kyte's findings assume added gravity in the light of the general consensus regarding the especially malevolent psychological effects of failure in the early grades, as noted by such writers as Bennett (46), Greene and Freden (244), Johnson (312, 315), Morgan (432), Washburne (650), and others.

Such innumerable listings of the characteristics of low-ability and "problem" children[17] as typified by the article by Boynton and McGaw (71), which note such behavior as being inattentive, being careless, lacking interest in work, refusing to study, disturbing class routine, whispering, etc., may well be regarded as only additional evidence of the failure of the educational program to anchor itself on the capacities and needs of the individual student. Of course, the factors of social and emotional maladjustment as well as of physical disabilities enter into the picture, but a truly comprehensive educational program must, of necessity, make allowances for all possible contributory factors.

Writers such as Anderson (10), Brown (84), Norsworthy (458), Scheidemann (550),[18] and Smith (566)[19] have noted that children have the same general make-up, differing largely in degree and amount rather than in the quality of various traits. In a great many cases, "difficult" children do not markedly differ from normal children in mentality, health, economic and social status, or academic standing. Many writers conclude that the intelligence of the feeble-minded does not form a separate species but belongs at the extreme position of some large distribution approximating the normal curve, and that there is an equal lack of mental ability in all directions, with all types of students showing about the same amount of unevenness of their abilities. A great deal of evidence exists to show that low-ability students are capable of emotional, social, vocational, and academic adjustment when the educational program is fitted to their limitations and needs,[20] and that they may even achieve success in mathematics itself.[21] Besides those who have attested to this, there is a long list of writers who advocate an individualized curriculum.

Educational retardation, then, suffers from the manifold implications of inadequate and controversial educational procedures as well as from the contributing factors of low mentality, emotional and social maladjustments, and physical disabilities all interacting one upon the other. How then, in the light of the complicated factors involved in contributing to what we will call the low-ability student, shall we define exactly what we mean by this category? For the purposes of this survey, the following definition is proposed. The low-ability student is any student who, owing either to low mentality, physical disability, social

[17] pp. 126-27 in bibliography.

[18] pp. 2-3.

[19] p. 166.

[20] See references 58, 84, 110, 147, 197, 205, 226, 323, 360, 374, 414, 476, 490, 511, 552, 557, 595, 642, 666, 675, 694.

[21] See references 27, 105, 126, 127, 141, 228, 270, 453, 497, 554, 563, 595, 632, 634, 676, 680.

or emotional maladjustment, improper pedagogical procedures, or a combination of any or all of these, fails to achieve certain standards in any one subject or group of subject-matter areas, when those standards have been fixed on the basis of the best available evidence resulting from objective, validated research on placement, evaluation, intelligence testing, etc., and when the objectives of the program are geared to the fullest possible consideration for the continuous and cumulative growth of each individual student by an educational methodology based on his interests, tastes, abilities, and personal and social needs.

In terms of this definition, a student who makes A's in every subject but fails in mathematics is a low-ability student in mathematics just as surely as is the student with an I.Q. of 75 who is failing in all of his subjects. And in these terms this paper shall seek to survey the literature on the subject of teaching persons of low ability generally, and of teaching them mathematics specifically, in order to set forth the consensus concerning the general methodologies advocated by these authorities. In many cases, effective methods with normal children are noted, because we believe that these methods are equally efficacious with low-ability groups. Furthermore, many methods reported successful on levels beyond the elementary school are cited in so far as they are applicable on the elementary level or as they reflect relevantly to the problems in that field.

Definition of "Low-Ability Student"

It is vital for any intelligent approach to the problem of the low-mentality student that there be a clear universal understanding among experimenters, teachers, and writers on the subject as to exactly what they mean when they refer to "problem children," "duffers," "low-mentality groups," "maladjusted cases," "backward students," or any of the other names by which they dub what we are calling the "low-ability" pupil. In order to do this, it is important for a great deal more research to be done on the nature and extent of the relationships which exist between the various factors which contribute to retardation in general.

For our purposes here, however, the next step is to find out in what general ways we may be able to help as much as possible the low-ability student as we know him. To that end, obviously, we must first be able to identify him among his fellows. The first step, therefore, in any program seeking to decrease retardation generally and disability in mathematics specifically, is to institute a comprehensive, intelligent, and scientific testing program in terms of certain prescribed objectives.

CHAPTER II

A COMPREHENSIVE, INTELLIGENT, AND SCIENTIFIC TESTING PROGRAM

Basic Need of Testing Program with Regard to the Low-Ability Student

A testing program designed to locate the low-ability student and to formulate a curriculum aligned with his abilities, tastes, interests, and immediate and potential personal and social needs is, obviously, the first step in any intelligent educational program on his behalf. Such an evaluation procedure would, of course, be equally beneficial to all students in the schools. The universal approval and description of such a testing program is notable throughout the recent literature on education.[1]

Qualifications of a "Good" Test and Objectives of the Arithmetic Program

Among the most important points connected with the development of a successful testing program the following seem most universally agreed upon.

1. Before an evaluation program can be instituted, it is essential to have the best testing devices obtainable. The following are among the points to be checked in selecting a "good" test:

   a. The validity of the test, i.e., the extent to which it measures the ability or accomplishment that it claims to measure, the general worth-whileness of the test, and the extent to which it parallels the curriculum being taught.[2] A test must be valid for its purposes in terms of the content and of the statistical determination of the value of the items included. Content is validated on the basis of such criteria as state and city courses of study, widely-used texts, research studies, recommendations of national committees, and teachers' examination questions. Statistical validation of the individual items involves proper interpretation of experimental data obtained regarding the difficulty of items, the range of difficulty, and the extent to which items differentiate different levels of ability.[3]

   b. The reliability of the test, i.e., the degree of accuracy of the measurement,[4] as evidenced by the extent to which pupils tend to obtain relatively the same score on it in successive testings. A test may be sufficiently reliable for measuring the average of a

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[1] See references 8, 15, 26, 30, 33, 49, 53, 55, 56, 59, 67, 78, 81, 86, 89, 100, 102, 103, 104, 105, 106, 110, 122, 126, 127, 131, 132, 133, 134, 137, 140, 148, 154, 161, 164, 167, 170, 171, 183, 191, 197, 203, 205, 215, 223, 232, 238, 241, 250, 251, 252, 253, 276, 278, 279, 280, 283, 297, 299, 300, 314, 316, 322, 325, 336, 339, 340, 351, 356, 361, 362, 363, 367, 368, 369, 378, 393, 397, 400, 401, 413, 424, 429, 432, 435, 439, 441, 448, 451, 461, 463, 466, 471, 473, 476, 478, 482, 486, 489, 491, 508, 509, 522, 523, 536, 550, 557, 566, 570, 577, 584, 588, 594, 595, 601, 602, 604, 606, 609, 617, 620, 628, 631, 632, 634, 635, 644, 660, 663, 669, 671, 672, 691, 694, 697, 702.

[2] Brueckner (100), p. 58.

[3] *Catalogue of Standard Tests.* World Book Co., Chicago, May, 1938. p. 67.

[4] Brueckner (100), p. 58.

group and yet not give a sufficiently reliable measure of an individual pupil's ability. Reliability may be expressed in terms of the probable error of a pupil's score in months of achievement and also as a coefficient of correlation between successive scores on the same test or on duplicate forms.[5]

c. The objectivity of the test, to eliminate as far as possible the subjectivity which such writers as Eisner (203), Hutchinson and Pugh (297), Langlie (361), Laugier and Weinberg (363), and Varner (625) have noted in their deprecations of the ability of teachers to judge pupil achievement and I.Q.'s objectively and accurately. This by no means indicates that teacher judgments are worthless; as is pointed out later in this chapter, they have an important part in a full measurement program, especially when the combined judgment of several teachers is used as an estimate.

d. The inclusion of adequate directions for ease and accuracy of administering, scoring, and interpreting the test, so that a beginner as well as an expert can effectively participate in these aspects of the evaluation program. As we shall note later, however, it is most desirable to have a highly-trained staff of workers for the testing procedures in the schools.

e. The cost of the test and the availability of equivalent forms of the test. The testing program, to be most effective, must be a regular one with periodic retesting and evaluation both to test the reliability and validity of the tests being used, and to measure the progress of the students under the curriculum and methods being used. To allow for this follow-up testing program, tests with equivalent forms should be chosen for use.

f. The norms of the test, which serve to make more possible an intelligent interpretation of the test scores and which should be included with the test.

g. The mechanical make-up of the test. The general appearance of the test should have a constructive effect on the student rather than an irritating effect caused by the presence of type of improper size, illogical and confusing arrangements of the various items, and inadequate or poorly-executed drawings and figures.

h. The objectives to be tested and the way in which they are tested. Even before any program for measurement for either diagnostic or evaluative purposes can be instituted, it is of prime importance to formulate the objectives towards which the program is to be pointed. Among the most generally accepted objectives[6] in this area are the following:

(1) To give the student a mastery of the necessary fundamental skills for computation and manipulation with ac-

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[5] *Catalogue of Standard Tests, op. cit.*, p. 67.

[6] See references 24, 47, 66, 110, 118, 130, 138, 140, 151, 153, 204, 387, 397, 398, 444, 465, 504, 555, 556, 557, 602, 656.

curacy and reasonable speed. For the beginning student of arithmetic this would entail the following:[7]

(*a*) The building up of a body of mathematical imagery comparable to the body of language imagery acquired before the formal study of reading has begun.

(*b*) The clarifying of simple quantitative relations as the child meets them in his own problems.

(*c*) The awakening of an appreciation of the value and need of units of measure for length, weight, time, cost, etc.

(*d*) The securing of an understanding of the essential number facts.

(2) To develop the characteristics particularly necessary for the understanding of mathematics and mathematical methods, such as the development of space intuitions; the training of the ability to discover and use relationships; the challenging of respect and appreciation for the beauty, truth, and power of mathematics; the strengthening of the ability to state clearly one's premises and build conclusions which do not violate them; the appreciation of the value of having suggested solutions pass in review and of evaluating them each in turn; the fostering of a critical attitude toward the reasonableness of results; etc.

(3) To develop such more general abilities as those of having desirable study habits; being accurate, neat, and aware of the value of a high quality of workmanship; being alert to see results and interpret correctly; desiring to improve and grow in skills; being precise in statement; having habits of thrift; having an attitude of inquiry which seeks to get at the bottom of things; being annoyed with vagueness and incompleteness, etc. One of the greatest needs in research on testing is the perfection of measurement devices to evaluate these less tangible factors in education in general, and in mathematics in particular.

(4) To give to the student, by the development of such qualities as described, a tool to facilitate clear, orderly, accurate, and quantitative thinking in every problem situation which he meets, and to develop the feeling for the value of proof over argument.

(5) To arouse the student's curiosity so that he will see more of the problems abounding all about him, and to enable him to see just how what he has learned can be transferred to other fields, to life in general, and to his own life in particular. To do this, such educational procedures may be used as that of giving him economic information that will help him in his own problems later in life and in a fuller understanding of community affairs.

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[7] McLaughlin and Troxell (387), pp. v ff.

(6) To develop an appreciation of the mathematics in nature, art, architecture, etc.

(7) To awaken the casual general public to an appreciation of the full implications of the mathematics program in the schools.

(8) To make the entire mathematical program meaningful to the student so that he may achieve the above-described objectives with a maximum of pleasure and profit.

These objectives will be qualified to some degree in the case of the low-ability student. This is particularly true with regard to such cases of this type as are rendered permanent by such uncontrollable forces as hereditary low mentality and permanent physical defects.[8] Some of the major qualifications to be considered with regard to the objectives outlined above are as follows:

(1) To educate the low-ability student to the level of his potentialities, giving him a reasonable mastery of the tool skills which have immediate and practical future applications for him in some vocation for which he is fitted and which may imply modified standards of progress and achievement in accordance with these potentialities.

(2) To enable him to make satisfactory social adjustments which will make him a fairly efficient adult at his own level. This will entail teaching him means of communication with those about him; obedience to the intelligent leadership of those who are more capable; constructive attitudes toward work; habits of thrift in money, time, energy, and material; and similar behavior patterns which will increase his self-respect and inculcate in him social attitudes which are not in conflict with society.

A great deal more research is needed to determine the validity and reliability of many of the so-called standardized tests and to make available to administrators of measurement programs data listing the most desirable tests. More scientifically established information is also needed concerning the extent to which many of these available tests duplicate or complement one another.[9]

2. A competent, well-trained staff of examiners for the purpose of choosing the best available tests, and for administering, scoring, and interpreting them as accurately and objectively as possible is essential to an adequate measurement program. A competent research department should be set up wherever possible.

3. Adequate physical facilities necessary for the execution of the testing work such as ample, well-lighted office space, good equipment, necessary stationery and record forms, clerical help, etc., should be provided for the staff.

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[8] See references 22, 105, 299, 300, 333, 389, 396, 397, 560, 594, 650.

[9] Such information would make much more usable a list of tests for determining proficiency in number work as presented by Klapper (340), p. 172.

4. The results of the testing program should be carefully tabulated on tables, charts, graphs, etc. and recorded permanently in a filing system in some readily-accessible and systematic order for the use of persons connected with the welfare of the children involved.

5. In the execution of the measurement program the fullest possible coöperation should be effected between all persons who may contribute constructively to the promotion of the program. Among these would be included school administrators; visiting, supervisory, and regular classroom teachers; psychologists, physicians, and nurses attached or available to the school staff; and neighborhood social and clinical workers.

6. The fullest possible coöperation with the testing program should be effected with the home and the community in order to gain their understanding help for and appreciation of the objectives of the program.

7. The fullest possible coöperation by the student being tested should be effected. It is essential to make him feel at ease, unafraid, and neither silently rebellious nor mischievously defiant. The best way to permeate this state of mind is to arouse the student's interest in the measurement program by making it meaningful to him and by showing him how he can help the school and its affiliated agencies to help him more fully to develop his talents in order that he may live a richer and more profitable life.

8. It is important to guard against an uncritical acceptance of objective measurement as an absolute and final solution to the educational problems involved. All of the factors influencing the life of the student in question should be investigated as fully as possible and interpreted as intelligently as possible. As Pullias (509)[10] sums it up, "A test may be objective in the sense that all personal opinion is eliminated in the scoring and still fail to remove important personal elements from the evaluation of pupil achievement. There are many factors (other than scoring) in the total measurement situation which cause marked disparity between the results from two or more new-type or objective tests constructed to measure the same functions." It is only by such a broad testing program that the generally accepted flaws in the present methods of measurement can be minimized, and that further research to eliminate these failings can be promoted. Among these shortcomings, we may note the following:

   a. The general lack of agreement concerning standards of achievement at certain age and grade levels which accompanies the wide confusion concerning the whole matter of readiness and grade placement.

   b. The indefinite placing of zero in scoring.

   c. The improper consideration, in arriving at the establishment of I.Q.'s, of the importance of such factors as ability to read in intelligence testing.

[10] Pullias, E. V. *Variability in Results from New-Type Achievement Tests.* Duke University, Durham, N.C., 1937. p. 79.

d. The relative failure to perfect adequate objective tests of such subtle and dynamic qualities as initiative, coöperation, needs, abilities, interests, appreciation, attitudes, emotions, and methods of working and thinking.

e. The frequent failure of I.Q. groupings to concern themselves with mental maturity.

9. The results of this broad testing program should be carefully and comprehensively interpreted in an effort to use the end results to find the causes of existing maladjustments and educational failings in terms of the subject's evidenced abilities, interests, and needs. Every case should be given the benefit of the doubt, with the fallibility of testing devices and makers as well as of the examiners themselves always foremost in mind. The wide heterogeneity of groups tested should also be kept before the interpreter of test results. Prognosis or prediction of outcomes should not be mistaken for an understanding of existing difficulties. The arrival at an I.Q. or mental age is not the answer to the problem of mental diagnosis. It is essential to get at the specific roots of the causes of the various failings which the measurement situation discloses, in order to deal with them directly in the remedial program which must follow. As Tiegs (606)[11] has stated, the I.Q. is a useful technique in that it is more accurate than teachers' estimates in detecting extremes in ability. While it is of little value in predicting individual achievement, it can be used very successfully in comparing the general levels of ability of various groups of children. This is all the more true with the low-ability group who are characterized by their highly varied and individualized behavior patterns. It is essential to find out why the slow student is slow. The interpretation of end results is valueless unless the examiners, teachers, administrators, and others concerned go to the roots of the matter and study the workings of the mind that produced those results. Herein lies the very heart of the entire testing program! Only in this way can one truly learn what the child really knows, and use that as the taking-off place for all future instruction.

10. The evaluation program should be instituted as early as possible in the formal school career of the student, as irremediable low-ability cases, especially, require early specialized training. An early measurement program would give teachers, administrators, psychologists, and others affiliated with the work of the school a chance to discover and utilize more intelligently the knowledges and skills possessed by the student at the earliest possible advantageous period. It would also enable these educators to capitalize most fully upon extracurricular interests and upon things the child has learned before beginning with his formal schooling. Thus, it would provide one of the few constructive leads we have for an adequate solution of the baffling problem of readiness and placement.

[11] Tiegs, E. W. "The I.Q. and Individual Guidance." *Educational Scene* 3:152-4, April, 1938.

11. A program of periodic re-examination, using the same tests, duplicate tests, or a graduated series of similar tests, should be instituted to corroborate or disprove the findings of the original measurement program, as well as to indicate the progress of the individual student and of the group.

12. Finally, a remedial and regular program of instruction should be instituted, based on the results of both the original and the recurrent testing situations and on the disclosed abilities, interests, tastes, and needs of the students both as individuals and as members of a group.

Types of Tests and Observational Techniques

As has been noted, the measurement program should utilize information from every available source in order to present as full and detailed a picture of the individual student as possible. The most widely advocated types of tests and observational techniques are listed below. These are not in the order of their importance, since they are all equally important in so far as they shed light on the individual in pursuance of the end just described:

1. Universally agreed upon is the necessity for a thorough physical examination of each and every student at regular intervals by qualified physicians and dentists.[12] Many educators also emphasize the need for instituting an adequate and comprehensive health program in the public schools as a necessary adjunct to solving the problems of the student.

2. The general consensus[13] stresses the value and necessity for psychological and psychiatrical examinations, i.e., the testing of such subtle and dynamic factors as those related to the emotions and personality, as an integral and inextricable part of an adequate measurement program. Others who support this thesis are among those who are concerned with the need for the establishment of psychological clinics either in or adjacent to the schools.

3. Intelligence tests are almost universally advocated by writers on the subject,[14] with an equally wide stress on the limitations of this testing procedure.

4. The use of achievement tests to survey or inventory the knowledge garnered and skills mastered by those being tested is another widely advocated type of measurement device.[15] Many of the items upon

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[12] See references 8, 11, 15, 25, 46, 48, 53, 60, 80, 126, 127, 131, 133, 135, 164, 178, 200, 232, 241, 250, 276, 280, 285, 286, 290, 299, 316, 369, 382, 424, 536, 583, 584, 590, 616, 621, 631, 635, 650, 671, 688, 691, 703, 704.

[13] See references 15, 48, 60, 126, 127, 133, 164, 167, 178, 200, 211, 232, 241, 299, 369, 382, 401, 432, 468, 559, 583, 590, 609, 613, 631, 633, 634, 635, 688, 698, 703.

[14] See references 8, 11, 20, 43, 47, 48, 51, 60, 100, 126, 127, 132, 160, 161, 164, 185, 187, 191, 211, 217, 232, 250, 251, 256, 276, 285, 286, 316, 317, 328, 356, 367, 369, 401, 424, 432, 435, 468, 469, 557, 559, 583, 584, 588, 590, 592, 595, 609, 613, 616, 621, 625, 633, 634, 635, 648, 650, 688, 690, 691, 703, 704, 706.

[15] See references 15, 48, 60, 110, 126, 127, 160, 172, 299, 316, 328, 340, 369, 471, 536, 557, 590, 609, 616, 635, 648, 669.

which students are tested on so-called "achievement" tests duplicate the materials presented in intelligence tests. As already noted, one of the chief failings in many intelligence tests is the neglect of the influence of such a factor as the ability to read in the assignment of I.Q.'s on the basis of total scores. Similarly, in many so-called "diagnostic" tests, the degree of achievement is discovered but the causes of failure are not diagnosed. It is important to note that the materials included in tests labeled with these various titles are not necessarily mutually exclusive, and it is, perhaps, impossible to make them so since the factors related to intelligence, achievement, and failure are all related one to the other. Because of this duplication, the necessity for a trained staff of examiners becomes all the more apparent in order to select measurement devices which will augment rather than repeat one another. Herein lies the necessity for much more research, as already noted, on the matter of comparing and standardizing available test materials and making the results of such research available to the administrators of measurement programs.

5. The use of diagnostic tests is widely advocated in the literature on the subject.[16] There are also many educators who support the general layout which is recommended for a diagnostic and remedial program in the schools.[17]

6. Aptitude, ability, and readiness tests are advocated by numerous writers.[18] In these tests, once again, confusion is rife. If the test purports to evaluate aptitudes, it may imply that such aptitudes are innate within the individual, and at once it will cause argument with those who stand firmly on the hypothesis that there are no innate or inborn abilities and aptitudes. On the other hand, if the test purports to see what abilities a student may exhibit as the result of his conditioning, it may be of great value in so far as it is cautiously used and wisely interpreted. If the test purports to evaluate a student's readiness to start the formal learning of some specific subject-matter area, the whole problem of readiness again arises. Such tests may yield valuable information concerning the individual being tested, if their limitations are kept definitely in mind.

7. The results of drill and review exercises and various scholarship examinations given by individual teachers, individual schools, or whole school systems may well be used to give added light concerning the individual being examined.[19] The subjective element which enters into the grading of such examinations, especially of the non-objective type, has already been commented upon and, once again, limits the validity and reliability of such materials. Again, however, these examinations may be used to considerable advantage by

[16] See references 80, 110, 131, 138, 140, 260, 340, 397, 427, 435, 441, 471, 621, 669, 670.

[17] p. 124 in bibliography.

[18] See references 48, 60, 80, 277, 316, 340, 609, 648.

[19] See references 8, 61, 97, 106, 126, 127, 130, 178, 191, 241, 256, 299, 322, 328, 340, 364, 367, 369, 557, 559, 583, 588, 601, 604, 609, 631, 634.

a discriminating, well-trained examining staff which keeps their limitations in mind.

8. Individual teachers' personal opinions of students and particularly the joint opinions of groups of teachers, although by their very nature highly subjective, are a valuable guide and index of pupil characteristics, abilities, and failings when this subjective element is given its due consideration by the examiners. Continuous daily and immediate contact with students, when intelligently exploited by teachers, brings about an understanding of many of those subtle and dynamic factors for which effective objective measurement devices have still not been acceptably perfected. Numerous authorities have commented on the values and usages of such materials in the testing program, especially when interests, traits, characteristics, abilities, and failings are listed to minimize the amount of subjectivity involved in the opinions forwarded.[20]

9. The results from oral preliminary examinations preceding the regular measurement program, as well as the results from personal interviews with the child and other informal diagnostic and observational techniques, are advocated by numerous writers.[21] One advantage of such informal interviewing is the utilization of the child's own suggestions for whatever light they shed on his case as well as for the value he incidentally receives from self-analysis of his abilities and shortcomings.

10. The results of observation by regular class teachers, supervisors, and visiting teachers, as well as by examiners, of the behavior of students actually at work under normal classroom conditions offer another lead to uncover many of the more subtle and dynamic factors for which suitable objective tests have still not been perfected. This technique is of particular value with low-ability students as a means of keeping one's finger on the pulse of doubtful cases by constant observation.[22]

11. A few writers, like Holmes (285) and Morrison (435), advocate the actual examination of parents as well as of children for any light which the results of such investigation may give on the problems of the children in question. A great many more stress the importance of family history as part of the necessary data in a comprehensive measurement program by their advocacy and description of the uses of, and the items to be included in, the writing up of a complete case history of every student being tested.[23]

12. Recurrently in the periodicals on education and educational psychology the results of various experiments and tests are reported for the benefit of others in the field facing similar problems. These

[20] See references 2, 8, 43, 51, 60, 86, 100, 126, 127, 164, 167, 187, 200, 203, 232, 286, 297, 328, 361, 363, 367, 463, 468, 508, 559, 583, 588, 595, 609, 616, 621, 625, 633, 635, 706.

[21] See references 100, 104, 105, 106, 131, 208, 235, 285, 286, 340, 435, 559, 590, 669.

[22] See references 105, 126, 127, 131, 137, 322, 413, 435, 454, 634, 669, 672.

[23] See references 15, 28, 33, 137, 183, 241, 299, 489, 559, 595, 609, 631, 634, 635, 688, 703, 704.

tests and experiments are usually neither standardized nor widely distributed, but the alert measurement staff will keep steadily in touch with all such reported materials for whatever leads they may provide for the many blank spaces still existing in the field of testing and evaluation as a whole. Most of the writers accept this statement as a truism and do not bother to mention it specifically, although a few persons such as Brueckner (106), Wallin (631), and Worlton (698) do comment on the use of such materials.

13. Finally, almost continuously throughout the literature on the subject there is a universal stress on the necessity for the keeping of continuous and cumulative records, charts, graphs, and similar materials as a basic factor in the measurement program.[24] It is difficult to overrate the inestimable value of such records in correlating and interpreting the various aspects of a full testing program. To those who advocate the keeping of such records may be added the writers who are later reported in the discussion concerning the advocacy of reforms in the matter of home-reports, many of whom propose sample types of progressive report cards in use in various places throughout the country.

A measurement program which will use the greatest possible combination of the most valid and reliable testing devices and observational techniques which are known, administered by a capable staff which always keeps foremost in its mind the fallibility of even the best tests available and remembers that its first duty is to the child being tested and not to the arbitrary evaluation devices being employed, is an integral and inextricable part of any educational program which seeks to help the low-ability students as well as the normal and brilliant students who comprise the school population. Through its intelligent, comprehensive, and objective execution we may be able to identify the low-ability student. This done, the next question is—what is to be done with him? This paper will attempt to survey the more general methods which have been advocated in his behalf, since specific recommendations are too numerous to discuss individually. The first step stressed by the writers on this subject is to place low-ability students in homogeneous groups on their own mental and ability level. This trend in methodology is discussed in the next chapter.

[24] See references 11, 15, 19, 25, 48, 100, 104, 126, 127, 131, 137, 140, 148, 164, 179, 187, 190, 223, 232, 241, 252, 279, 299, 316, 322, 328, 340, 390, 401, 435, 437, 468, 485, 557, 577, 601, 616, 631, 634, 635, 669.

CHAPTER III

HOMOGENEOUS GROUPING

The advocacy of homogeneous grouping as the first step in the educational program which seeks to base itself on the interests, tastes, abilities, and immediate and potential personal and social needs of the individual students is almost universal in the literature on the subject. Administrators and teachers have reported grouping plans which have brought about marked improvement in the achievement of their students. Reports of experiments with controlled groups show the superior quality of the work done by the homogeneous group, and innumerable theoretical discussions substantiate the device on the basis of good educational thinking.

Definition of Homogeneous Grouping

A basic confusion, however, is evident in the literature. As Coxe (165)[1] points out, it is the failure of the writers on the subject to distinguish clearly between what is called "ability" grouping and what is called "homogeneous" grouping. Coxe attempts to point out the differentiation as follows:

> The point of differentiation between homogeneous grouping and ability grouping is that the former is looked upon as a device for improved achievement in certain standardized subject matter, whereas the latter is for the purpose of developing certain more general abilities, and that subject matter is used merely as a means to this end.

While a few other writers have also tried to split hairs in making a distinction between the two terms, in most of the literature on the subject the writers themselves seem to use the two terms interchangeably. However, the great majority of authorities are agreed on the advantageousness of some plan of homogeneous grouping.[2]

It seems advisable here to formulate some definition of "homogeneous grouping" which will serve the purposes of this paper. Homogeneous grouping, we may say, is a device whereby students of similar abilities, interests, tastes, and immediate and probable needs, as demonstrated on the basis of a comprehensive measurement program, are placed in groups for the purpose of administering an educational program best fitted to their individual differences, and from which they may obtain the fullest possible development of their individual potentialities for the greatest good of each individual as well as the greatest good of the greatest number within the social group. However, we do

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[1] Coxe, W. W. "Our Homogeneous-Grouping Confusion." *Journal of Educational Research* 25:4, January, 1932.

[2] See references 8, 11, 12, 13, 20, 25, 26, 37, 43, 46, 49, 51, 53, 54, 55, 56, 60, 78, 80, 97, 110, 121, 124, 126, 127, 129, 132, 135, 141, 144, 145, 156, 157, 158, 160, 161, 162, 163, 164, 165, 166, 167, 175, 177, 178, 183, 185, 186, 187, 191, 198, 204, 214, 216, 232, 238, 250, 252, 253, 256, 265, 269, 272, 290, 292, 299, 316, 326, 328, 330, 333, 335, 340, 351, 354, 357, 359, 367, 368, 369, 374, 378, 384, 391, 400, 403, 413, 417, 419, 424, 435, 436, 467, 468, 475, 479, 486, 488, 491, 498, 513, 536, 551, 583, 588, 590, 595, 599, 601, 607, 608, 616, 628, 631, 632, 633, 634, 635, 637, 638, 640, 648, 657, 661, 664, 688, 689, 690, 698, 699, 703, 705, 706.

not offer this definition as final and all-inclusive, for much research should yet be done to distinguish between homogeneous grouping and ability grouping.

Advantages of Homogeneous Grouping

The *Ninth Yearbook of the Department of Superintendence* (177)[3] summarizes the advantages of homogeneous grouping, which serves as an admirable composite picture of the major advantages stressed by writers on the subject. These are as follows:

1. Homogeneous grouping makes differentiation of curriculum easier. There is better opportunity for differentiation of courses of study without resorting to individual instruction. It takes care of the assignment problem.

2. Slow learners in separate groups are not discouraged by the superiority of others, but compete on more equal terms and develop their own leaders. Grouped together, pupils feel freer to admit their slowness and to ask the questions necessary to their better understanding. They do not feel awkward or timid through being conscious of the brighter and faster pupils.

3. Homogeneous grouping places pupils in competition with others of fairly equal ability. It sets a pace that is a real challenge and a standard that is attainable.

4. Children having more than average ability tend to form habits of idleness, inattention, and mental laziness if compelled to mark time in classes made up of average and below average pupils. When superior pupils are grouped together activities and discussions are on a higher plane. Greater opportunity is offered for more oral expression that others can follow.

5. Homogeneous grouping enables the teacher to adapt methods of teaching to meet the needs of varying groups. He does not have to interest all in a presentation fitted only for a few. He can make a much more effective division of the time allotted to development, drill, and application. He is allowed more latitude in experimentation.

6. Homogeneous grouping facilitates the work of the teacher. It is easier to teach a more nearly homogeneous group. The faster groups can be made larger and the slower groups smaller, so that the latter may receive more individual attention. Since the range in the ability of the group as a whole is so much less the teacher sees more clearly the needs of each individual.

7. Competition is keener, pupils are more likely to work up to their capacities—better work results.

8. Homogeneous grouping adds to the happiness of children. The sting of inferiority and failure is removed. Each child is happy achieving in his group and experiencing the joy of success.

9. Homogeneous grouping lessens pupil failure and discouragement and reduces the amount of retardation. The slow pupil is not constantly compared with the bright child.

10. By limiting the range of variation within a group, more time can be given to the individual pupil. Individual instruction is made easier, special interests can be emphasized, and special aptitudes and abilities developed.

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[3] Department of Superintendence of the N. E. A. "Arguments for and Against Homogeneous Grouping." *Yearbook of the Department of Superintendence* 9:122-3, 1931.

11. Leaders are developed in all groups. Every homogeneous group, so-called, lacks enough in homogeneity to furnish leaders for the slower portion of the group, without the danger of the leaders getting so far ahead that they cease to function as such.

12. Homogeneous grouping reduces the number of disciplinary problems, by giving pupils work suited to their abilities and a chance to succeed among their equals.

13. Homogeneous grouping usually provides groups which are more congenial socially. It associates together those who may best profit from coöperation and competition.

14. Homogeneous grouping makes for more flexible promotion. It permits adjustment of standards of achievement to varying levels of ability with the result that more just standards of rating and promotion usually obtain.

15. Homogeneous grouping prevents the development of an inferiority complex on the part of the dull.

16. Homogeneous grouping prevents the development of a superiority complex on the part of the bright. It is possible that a better attitude toward his own ability may result if a pupil is matched with his peers.

17. There is opportunity for better teacher preparation. Teachers may specialize in teaching the group in which they are most interested.

18. The teacher with the so-called "best" group works harder because he knows that more is expected of his pupils.

19. Homogeneous grouping prevents low standards from dominating the whole group.

20. A greater retention of pupils results from homogeneous grouping.

Many of these advantages resulting from and inherent in the homogeneous grouping device are more fully discussed, in the ensuing two chapters, with relation to their especial importance in the teaching of the low-ability student.

Disadvantages of Homogeneous Grouping

There is, as well, a long list of writers[4] on the matter of homogeneous grouping who present evidence that this scheme, on the basis of the results obtained in actual classroom use and in experiments using control groups, is not workable and does not solve the problems it seeks to alleviate. Many of the points which these writers note are also commented upon by those already listed who advocate homogeneous grouping while pointing out its limitations and dangers. The most noteworthy criticism that can be made offhand of a good number of those in the anti-grouping camp is that, although they may have instituted homogeneous grouping in their respective experiments and schools, they have failed to make adequate differentiation in curriculum and methods to care for the individual differences of the various groups and the individual students within these segregated sections. Perhaps the most general of their criticisms are summed up, again, in the *Ninth Yearbook of the Department of Superintendence* (177),[5] as follows:

[4] See references 64, 75, 195, 311, 331, 356, 380, 383, 386, 493, 510, 624.

[5] Department of Superintendence of the N.E.A., *op. cit.*, p. 124.

1. With homogeneous grouping, the slower groups lose the stimulus and the contributions of the brighter pupils.

This point is one of the most widely discussed in the whole argument concerning homogeneous grouping. There are many advocates of the device who take notice of this shortcoming but who believe it may be minimized, if not entirely eliminated, if the pupils in slow sections are given every possible chance to associate with more gifted students in extracurricular activities and similar areas of education wherein they may meet their superiors on more equal terms. They further note that, if a student is retarded in mathematics, for example, and normal in his other subjects, there is no conceivable reason why he should be placed in a slow group for his entire schedule. In such cases, the low-ability student in arithmetic has the contacts he needs in his relationships with his fellows in his regular classes. In addition, these writers stress the fact that students who become retarded in one or two subjects and have to be placed in slow groups for those areas should be returned as soon as possible to their regular class groups. Many of the writers on the subject call this latter arrangement "opportunity class" grouping.[6]

Several of the superintendents reported in the *Ninth Yearbook of the Department of Superintendence* note that this argument is not valid for the following reasons:[7]

a. Even when pupils are grouped homogeneously there is still a sufficient range of ability within each group so that the more capable pupils set standards for the less aggressive who need to have their pride awakened to work up to capacity.

b. The power gained by a certain few of the lower groups who become leaders in their groups fully takes the place of anything they might gain if they were in classes in which brighter pupils are leaders.

To resume the listing of the disadvantages noted in the same yearbook:[8]

2. Pupils put in the lower ability groups sometimes develop a sense of failure and inferiority.

3. Pupils put in the higher ability groups are apt to develop a superiority complex. It may cause bright pupils to under-evaluate the worth of qualities other than intellect, and thus promote intellectual snobbishness. It prevents brighter children from learning tolerance for those with less intellectual ability.

4. Homogeneous grouping is undemocratic and tends to create class distinctions in the minds of some pupils. Through it there is danger of developing an intellectual caste.

5. The adjustment of teachers to the various groups is difficult, particularly the lower groups. Some teachers object to teaching the dullest group. Relatively few teachers can handle this group competently.

6. With homogeneous grouping, there are no outstanding leaders to inspire slower groups. The slow child may become discouraged and even slower.

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[6] See references 8, 26, 53, 55, 104, 110, 126, 127, 158, 166, 177, 183, 214, 299, 311, 341, 357, 362, 377, 435, 476, 486, 635, 655, 656, 657, 664, 706.

[7] Department of Superintendence of the N. E. A., *op. cit.*, p. 124.

[8] *Ibid.*

7. It is very difficult to divide pupils into truly homogeneous groups, for a group that is more or less homogeneous in one subject may be heterogeneous in another. To illustrate, a group that has more or less the same ability and test scores in arithmetic may differ widely in ability and test scores in geography.

This matter of the great variability and heterogeneity among the individuals of any homogeneous group, and especially among duller students, has been repeatedly mentioned by the various writers already cited. Even under a plan of homogeneous grouping according to subject-matter areas it is vital to remember that the inevitable heterogeneity of the pupils can never be completely eliminated, and it is doubtful whether the elimination of such individual differences is at all desirable. The only effective educational procedure under any system will seek to capitalize upon and develop these individual differences for the fullest possible development of the potentialities of the individual.[9]

To resume again the listing of the disadvantages which appear in the *Yearbook*:[10]

8. A certain stigma is often attached to the lower groups, and they are referred to as "dumb-bells."

9. Homogeneous grouping is sometimes misunderstood and resented by parents.

10. Few teachers succeed in adequately differentiating the materials of instruction. They do not know how to handle the differences in groups, especially for the upper and lower thirds.

11. Homogeneous grouping complicates school administration, makes the mechanics of promotion and sectioning more difficult, and requires closer scheduling.

12. Homogeneous grouping is impossible or difficult except in schools of considerable size. If tried in small schools, it makes too many groups, which necessitates the preparation of too much work by the teacher.

13. There is a tendency for teachers to be complacent with low achievement in low groups. Some teachers of "Z" sections do not feel the need of putting extra effort into their work, since they feel that little can be expected of these dull groups.

14. Grouping on an ability basis frequently results in pupils with poor social background being all grouped together, whereas citizenship improves by association with higher type pupils.

15. There is a tendency for teachers to view grouping as a substitute for individualization rather than as a device for increasing its efficiency. Teachers tend to deal with a class as if all the pupils in it were equally bright or equally dull in all subjects, instead of studying individual differences—the result is that the individual is submerged.

16. The average, or above average pupil, loses the opportunity of helping the dull child.

17. It is difficult to maintain a right attitude on the part of the pupil toward the grouping, particularly in the slow sections. Homogeneous grouping, if not properly handled, causes jealousy and resentment.

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[9] See references 30, 80, 84, 86, 102, 124, 156, 173, 174, 191, 214, 256, 283, 284, 384, 386, 400, 414, 427, 475, 511, 522, 523, 557, 586, 595, 607, 635, 645, 650, 675, 690, 706.

[10] (177), pp. 124-5.

18. Homogeneous groups, whether based on ability or achievement, are only relative. There is much overlapping of ability, intelligence, and achievement in most so-called homogeneous groups.

19. The poor group accomplishes little because the teacher "knows" they can't do much. Fixed attitudes with respect to intelligence are developed by teachers in dealing with pupils grouped homogeneously—usually to the disadvantage of the low ability groups.

20. Some pupils will deliberately do poor work so as to rate low in tests in order to get into slow groups, as less work is required of them there.

21. Discipline cases usually collect in the low division.

22. Homogeneous grouping offers no advantage to a school with an activity program and a correlated curriculum. It is only advantageous when a formal curriculum is followed. Unit methods within the class have obviated to a large extent the necessity of homogeneous grouping.

Analysis of Disadvantages of Homogeneous Grouping

Most of these so-called disadvantages, with the possible exception of the last one noted, may be rather readily refuted or negated in much the same manner as the first and seventh points. A large number of the objections to homogeneous grouping are, in reality, not true objections at all since they do not conclusively negate the grouping plan, but, rather, are condemnation of ineffective teaching and administrative personnel. Among these may be included points 5, 10, 11, 12, 13, 15, 17, and 19. The extra effort which is disparaged in these arguments would certainly be worth expending if the results warranted the exertion necessary. Still other points like numbers 2, 3, 6, 16, and 21 are cancelled by the equal, if not greater, stress on the very opposite reaction resulting from homogeneous grouping as listed by many superintendents in the enumeration of the advantages of the plan. Point 18 parallels the argument in point 7, which has already been discussed. The disadvantages listed in points 4 and 8 are equally possible under the conventional type of school administration, as are numerous others of the so-called disadvantages listed. Point 9 is negated if the school complements its program with an adequate publicity campaign to gain the support as well as the coöperation of the parents and the community. The objection listed as point 14 is also equally possible under a conventional grouping plan, and further, the meaning of the term "higher type" pupils is not clear. Point 20 would be negated if a broad and comprehensive testing program, such as has been described in Chapter II, preceded the setting up of homogeneous groups. Finally, concerning point 22, activity programs and correlating activities may well be substituted for homogeneous grouping in that they offer each individual some part of the whole program which may be suited to his particular abilities, interests, tastes, and needs. On the other hand, they may also be constructively used with homogeneous groups with equal or even greater advantage than with heterogeneous groups wherein a great many of the disadvantages suffered by the low-ability student in competition with his superiors may still exist.

In conclusion, we feel that it is safe to say that the wide consensus of authorities and the results of controlled experiments seem to favor some type of homogeneous grouping. Furthermore, the most desirable form of such a plan would be in terms of subject-matter areas (where core-curricula are not in effect) with a student grouped with others on his own level in each particular area. Under this plan a student may well be in a slow arithmetic class, a regular geography class, and an accelerated English class. Once we have placed the student in such groups, on the basis of a broad testing program such as has been described, we are faced with the problem of what to do with him in the way of differentiated curricular materials and methodologies. While our main concern in this survey is with the low-ability student in arithmetic, it is well, first, to note the most widely stressed general methodologies which would apply in his case, as they are presented in the literature on the subject.

CHAPTER IV

PROVISION FOR INDIVIDUAL DIFFERENCES BY FLEXIBILITY OF METHOD

We shall attempt to outline certain general methodologies which have been reported and generally approved in the literature concerning the teaching of atypical as well as of normal children. As the commentators in the Report of the British Mathematical Society (595) and numerous observers such as Woody (694) have pointed out, the general laws of learning seem to be followed in most educational procedures. Successful methods used with low-ability students have usually proved efficacious with normal students as well, and vice versa. Throughout this paper, incidentally, the term "method" is used in the same sense that Kilpatrick used it in his *Foundations of Method*, that is, it involves the total learning situation including curriculum, teaching devices, materials, etc.

Many writers[1] have at various times advocated an empirical approach with regard to the teaching of low-ability students; namely, that of utilizing any method which has proved itself efficacious in actual practice. An alert teacher will never reduce his method to rote formula, but will ever be active in the pursuit of the myriad little tricks of pedagogy which will reward his efforts with success. However, the purely empirical approach is much too catch-as-catch-can and desultory and wasteful as a method used all by itself. Robert Burton many years ago noted that "a dwarf standing on the shoulders of a giant may see farther than the giant himself," and this is the basis for all progress in education. We build upon the reports of the observations and the experiments of our forebears, and to this end we make this survey of the widely-advocated teaching methods. These methods, however, must ever be tempered in the white heat of the immediate teaching situation with regard to the abilities, interests, and needs of each individual student. They simply offer a broad attack on the vital problem of the teaching of mathematics to the low-ability student in the elementary school.

The first two steps in any general solution of this problem have already been described; namely, (1) the administration of a comprehensive, intelligent, and scientific testing program; and (2) the setting up of homogeneous groups on the basis of the results of such a program. These measures, in the order named, are prerequisites for the various methods described in the ensuing chapters, of which the most vital and widely stressed is that of providing for the individual differences disclosed by the testing program and cared for through the homogeneous grouping of pupils with similar abilities. This becomes, logically, the third step in the provision for the fullest possible continuous and cumulative intellectual, emotional, and physical growth of the low-ability student within the limitations of his various capacities.

[1] See references 11, 55, 90, 95, 110, 300.

Definition of Individualization

Throughout the literature on the subject there is an almost universal emphasis on the basic need for the individualization of the methods and materials of instruction according to the capacities and needs of each student both individually and as a member of a group. The advocacy of an elastic curriculum based on equally elastic standards and objectives in keeping with these differences is the direct educational heritage of a long line of progressive schoolmen including Burke, Cattell, Dewey, Froebel, Herbart, McDade, Morrison, Parkhurst, Pestalozzi, Rice, Rousseau, Thorndike, Search, and Washburne. Individualization, as Courtis (161) defines it and as it is used in most of the references noted, refers wholly to the *process* of adjustment and in no way to the product of that adjustment. Or, as Courtis puts it in another report (160), individualization is "the attempt to adjust education to the nature of the individual."[2] That is, individualization does not aim to increase the ruggedness of a person's individualism.

The constant reorganization and variation of content of the curriculum, rates of progress, and methods of work, it is repeatedly stressed, will do much to eliminate the truancy, incorrigibility, delinquency, and social and emotional maladjustment which are factors in the backgrounds of many of the low-ability group. Educators must specialize on the strengths instead of the weaknesses of the individual student to keep him away from the abyss of socially unacceptable behavior and social incompetence. This does not imply a makeshift, irregular, and chaotic school administration, but rather a system which allows for change in keeping with the findings of the latest research, and which specifically allows for any necessary immediate variations which may arise in individual cases.

Such a program, in turn, should be executed by a staff of administrators, teachers, and other affiliated officials (as described in detail later in this chapter) who are both alert to and intimately sympathetic with the needs of students in their charge. The fullest possible development of the individual as a whole within the limits of his capacities, and *not* growth in any specific school subject, should be the ultimate framework wherein the public school educator must operate. With such objectives conditioning differentiation and resulting in properly motivated presentation of materials, each child may well be stimulated to work up to the level of his own ability. He would be competing largely with his own record and in homogeneous groups with his fellows on his own approximate level. Writers stressing individualization, incidentally, make a major point of the fact that homogeneous grouping in and of itself solves none of the problems related to the low-ability student. Unless grouping is accompanied by the fullest possible differentiation of methodology, materials, and curriculum to allow for individual differences, this device becomes an empty, meaningless, and useless gesture.

[2] Courtis, S. A. "The Evolution of Individualization: An Interpretation." *Educational Method* 15:292, March, 1936.

Among many of the writers on the subject the stress on individualization is part and parcel of the diagnostic and remedial program. Their reports emphasize the use of an individualized remedial technique to follow the diagnostic and testing program, a technique which deals directly and specifically with the difficulties involved. This carrying of individualization to its minutest applications is particularly of importance in such matters as clearing up common difficulties with the fundamentals in mathematics or with grammar in English, for example. Individualization, further, implies the adjustment of methodology to changing needs as they are evidenced on repeated examinations. This flexibility must be steadfastly maintained, since, even though external difficulties may seem to have been cleared up, deep-rooted differences will long remain; and if these are neglected in the light of certain superficial successes, they may well spring into active evidence again in new and more potentially serious maladjustments.

Need for Flexible Curriculum and Method

All of the numerous involutions of the points discussed in the past few pages run throughout the writings of the host of authorities[3] who stress the need for a flexible curriculum and methodology in keeping with the requirements of individual students. Courtis (161) sums up the general position of these authorities when he concludes, "In terms of subject-matter efficiency, teaching effort, and cost, the individualized schools appear to hold their own with the more formal schools; at the same time to give richer products in terms of those aspects of individual development and culture that all progressive educators value."[4] By the sheer force of numbers these educators overshadow the exponents of the theory that the curriculum should be wholly grounded on the activities, interests, and problems of the adult society in which the children live. The advocates of differentiation in terms of the child's immediate interests, tastes, and abilities make ample provision for the chief arguments of this opposing school of thought in the stress on providing also for the immediate *as well as potential* needs of the individual child.

Need for Informal Presentation

Any educational program which allows for the individual differences which exist among all students requires two basic methodologies. The first of these, as has already been stated, is the administration of an

[3] See references 2, 8, 10, 12, 13, 14, 15, 21, 25, 30, 46, 49, 51, 52, 53, 54, 55, 56, 59, 65, 66, 72, 78, 80, 81, 86, 89, 92, 100, 103, 104, 110, 111, 118, 126, 127, 129, 130, 131, 132, 133, 135, 140, 152, 154, 155, 156, 157, 160, 161, 163, 168, 177, 178, 179, 183, 189, 191, 193, 195, 198, 204, 212, 214, 217, 222, 231, 232, 233, 234, 243, 250, 256, 257, 260, 269, 274, 280, 290, 291, 292, 299, 311, 312, 315, 316, 324, 326, 330, 333, 335, 340, 351, 355, 356, 357, 360, 362, 367, 369, 382, 388, 389, 393, 396, 397, 400, 403, 405, 406, 413, 419, 424, 435, 438, 440, 441, 444, 457, 464, 466, 467, 468, 471, 475, 478, 483, 486, 489, 491, 499, 507, 521, 522, 523, 529, 536, 538, 539, 541, 557, 562, 563, 571, 577, 581, 583, 584, 588, 594, 595, 602, 603, 604, 613, 619, 623, 628, 633, 634, 635, 643, 644, 645, 648, 650, 653, 654, 657, 664, 668, 669, 671, 672, 682, 685, 689, 690, 691, 692, 694, 696, 701, 703, 706.

[4] Courtis, S. A. "Contributions of Research to the Individualization of Instruction." *Thirty-Seventh Yearbook of the National Society for the Study of Education*, Pt. II, Ch. 17, p. 209. National Society for the Study of Education, 1938.

evaluation program which will give educators a picture as full as possible of the individual differences of the pupils as can be detected by means of all the techniques and devices available. The second of these is the minimizing, as much as possible, of formal presentation of subject matter. With regard to mathematics, the importance of learning through activities, such as shop work in wood, metals, electricity, etc.; drawing; nature study; gardening; model building; domestic science courses in cooking, sewing, decoration, etc., is stressed by numerous writers[5] who advocate such activities as a means for presenting educational materials informally, especially to students of low ability.

General Methods for Flexibility

To these may readily be added the many authorities who stress informality in the presentation of subject matter in general and the facts and processes of mathematics in particular.[6] Throughout most of these references is the emphasis on the problem of readiness, which is discussed more fully in the ensuing chapters. Suffice it to say at this point that the main argument projected is, as Brownell (92) sums it up from Buckingham,[7] that most elementary school children, in their first two years especially, are incapable of learning (i.e., they are *unready* to learn) abstract arithmetic when it is presented through the usual mechanical drill techniques and devices. On the other hand, it is generally agreed that elementary school children can learn (i.e., they are *ready* to learn) much arithmetic when that arithmetic is met incidentally and informally in the service of their needs. Among such incidental situations are those listed by Inskeep (300),[8] including counting children, chairs, pictures, and other similar objects, as well as reading symbols attached to pictures; e.g., the symbol "5" on a picture with five birds on it. Games of various sorts, such as are described in the next chapters, offer another rich source for the informal, incidental, and pleasant as well as profitable means of guiding the first steps of youngsters in the wonderland of number. A flexible curriculum and general methodology is the best means of capitalizing on the wealth of informal mathematical experiences of preschool and elementary school children.

Also included among the supporters of the argument for informality may be those who advocate such methodologies as integration and the use of real-life situations which are integrally and inextricably a part of any attempt at informality of presentation. Generally speaking, in agreement with the writers already cited on this point, the advocates of these methods note that objective and creative methods are most efficacious with the emphasis placed on experience rather than on book-learning, and with word knowledge and memory not confused with true knowledge and judgment of things and reality. Such learning

[5] See references 8, 11, 21, 26, 29, 53, 55, 56, 60, 68, 78, 110, 126, 127, 135, 162, 164, 178, 185, 204, 232, 234, 250, 293, 299, 300, 340, 362, 374, 381, 393, 396, 397, 461, 482, 491, 512, 515, 550, 557, 595, 602, 626, 632, 634, 650, 655, 668, 675, 691, 703, 705.

[6] See references 91, 92, 123, 130, 140, 155, 278, 312, 356, 435, 440, 442, 540, 553, 592, 649, 693, 695.

[7] Buckingham, B. R. "When to Begin the Teaching of Arithmetic." *Childhood Education* 11:339-43, May, 1935.

[8] p. 126.

resulting from informal experiences with and talks about number problems in real-life situations, especially in the first two years of formal schooling, stimulates the acquisition of basic and necessary skills largely as the result of the students' own initiative. The formal aspects of arithmetic, or pure arithmetic as Johnson (312) puts it, should always interplay with social arithmetic throughout the child's formal schooling. This is particularly true with low-ability students who need added training in social effectiveness.

Such informal procedures do not slow down the student nor put him at any disadvantage. On the contrary, they provide a natural step in his development as a whole individual. Especially is this true in the first few years of formal schooling in serving to bridge the treacherous gap between the preschool period of learning, with its natural spontaneity and aimless impulsiveness, and the formal period of education in the schools, with its carefully planned objectives and methodologies.

It is important to note, however, that, while teaching may proceed in the informal, incidental manner described, the instruction must be very definite and well planned in the mind of the teacher if it is to be effective. By no means do these writers seek to discourage adequate class preparation on the part of the teacher in charge; and the lazy, apathetic, and inalert instructor willing to follow these procedures only as the line of least resistance will find his efforts a maelstrom of educational chaos. Informality of presentation requires an unusually alert, well-grounded, and all-observant educator to make such procedures effective. Even in formal educational procedures, the inalert, apathetic, poorly-grounded, lazy teacher who fails to have his objectives clearly in mind and neglects to provide carefully planned lesson presentations provides one of the main causes of failure and so-called "low ability" on the part of many students. In fact, all of these methodologies bog down miserably and break on the rocks of incompetent teaching personnel.

We may now turn to an examination of some of the major means of promoting a flexible educational program for the benefit of low-ability groups which we find stressed in the literature on the subject. These are as follows:

Less coverage of ground.—One of the most widely advocated devices contributory to a flexible methodology in keeping with individual limitations is that of covering less ground with those who are less able, mentally, to achieve in terms of certain arbitrary subject-matter goals. This device is especially valuable in the early elementary grades. It is educationally unsound to expect any student to achieve beyond his capacities with respect either to the quality or the quantity of the work presented. Gradual transitions must be effected between various arbitrarily set-up divisions of subject matter, which, at best, can never be mutually exclusive. The teacher of the low-ability student, in particular, must make sure that the student masters each of the facts and skills of the arithmetic taught him when he first encounters it, even though this may entail much repetition. Such repetition should be executed by presenting the material in an ever-changing variety of forms to maintain the student's maximum attention and interest. Repetition to the

point of overlearning is far more efficacious, educationally, than superficial underlearning geared to speed and competition.

The student must never be burdened and confused with too many facts and skills which he is required to learn at once. If he is allowed to proceed from one thoroughly learned step to another, it will encourage him to be confident and independent in his responses. This feeling of confidence and independence and the sense of pride resulting from success are especially important to the low-ability student, and must be maintained at any cost. Even after the student has seemingly mastered some fact or set of facts, or some skill or set of skills, if he later shows loss of that mastery these facts or skills should be retaught to him as painstakingly, if necessary, as they were taught to him in the first place, and their correlation to the advanced work should be pointed out to him. Only by such means may true educational economy be effected. Low-ability students, as has been noted, lack certain abilities to see fully the relationships between things learned and to gain significance from concepts. All thinking or new learning must be on the basis of past experiences, and the low-ability student is less adept than the normal student at assimilating and generalizing upon these experiences. As a result, he usually learns differently with each new situation and requires a slow pace to allow for repeated though varied directions, explanations, and relationships pointed out by the instructor.

It is of the utmost importance for elementary education, especially for the low-ability student, that the teacher remember that the early number concepts of children are the result of a slow process. At no time must the pupil of low mental ability be required to do too much in the highly abstract realm of number. The great controversy raging on the whole matter of readiness and placement of mathematics attests to the importance of giving the student every benefit of the doubt; and for the low-ability student this means, for one thing, the covering of less ground than may be demanded of his more capable fellows.[9] Future research may well show that much less coverage of ground than is hurried over today is scientifically desirable even in the case of normal and brilliant students. One of the most vital problems facing present-day research is the setting up of rates of learning and standards for placement of material according to mental ages as demonstrated by students on testing programs.

Simplification of materials and setting of minimum essentials.—The second major device for modification of methodology to render the educational framework more flexible in terms of the capacities and needs of low-ability students is the simplification of the subject matter presented, and the setting up of minimum essentials to be mastered by these students. This is especially valuable in the teaching of such tool subjects as mathematics to slow pupils. The materials presented, particularly in the early phases of formal education, should be in simple situations, accompanied by applications to specific experiences in life

[9] See references 32, 88, 94, 100, 110, 121, 126, 127, 141, 160, 163, 178, 204, 208, 250, 262, 263, 288, 290, 291, 298, 299, 300, 312, 315, 329, 337, 340, 344, 350, 355, 356, 389, 390, 396, 397, 405, 413, 432, 441, 448, 471, 482, 491, 502, 521, 553, 557, 585, 588, 594, 595, 604, 634, 649, 652, 663, 664, 669, 682, 694, 705, 706.

such as finding page numbers, counting change in store transactions, finding weight gains over specific periods of time, estimating the cost of a party, keeping scores and averages in various games and sports, reading temperatures and other meters, and estimating the value of time expended on a certain job.[10] The simplification of materials presented to the low-ability student is largely dictated by his short attention span and his lack of ability to comprehend the abstract and to generalize and see relationships.

Mathematics is among the most highly abstract of the sciences, and the educational precept which dictates a continuous and cumulative learning situation proceeding from the simple to the complex, from the known to the unknown, and from the concrete to the abstract becomes especially significant in the teaching of mathematics. As is noted in the ensuing chapter, almost all the writers on the subject stress the necessity for making the work presented to low-ability students as concrete as possible. The slow student must be complete master of the simple and concrete and must be able to generalize properly to the limit of his ability with the materials he has mastered before proceeding to more complex matters. In the most extreme cases of low ability, this will mean that abstract materials will never be presented to the student. This again raises the important problem of scientifically setting standards of progress in learning according to mental age, complicated in this instance by the need for the scientific determination of what should be the minimum essentials demanded of low-ability students. As La-Brant (356) has pointed out, these minimum essentials must not be regarded as substitutes for the work required of more brilliant students, "substitute" implying that the thing offered is less desirable than the object for which it is a substitute. Simplified materials and modified courses must be regarded as normal work rather than as substitutes for the students for whom they are offered.

Implied in the general stress on the simplification of materials and a continuous and cumulative learning experience is the necessity for regular and specific assigned tasks. This is especially important with the low-ability student who lacks the initiative and imagination, in many cases, of his more talented fellows. Also implied in this device is the universal stress on a more flexible system of reporting on progress and of promotion and retardation which is discussed as the fifth means suggested for a more flexible methodology. Simplification of materials is also necessary to allow the low-ability student to achieve success and to bolster his confidence. The child should always be encouraged to perform at levels at which he can enjoy, understand, and profit to the utmost from his work without loss of time from unnecessary dawdling. However, this does not imply that the teacher should cram the low-ability student with a few simple, mechanical responses. On the contrary, the complete mastery of the simple should ever be the taking-off place to the more complex as far as the capacities of the individual student will allow. Woodrow (691)[11] sums up the entire matter of simplification, even with regard to normal students, as follows:

[10] These activities are listed by Ingram (299), p. 65.

[11] Woodrow, H. H. *Brightness and Dullness in Children.* J. B. Lippincott Co., Philadelphia, 1919. p. 141.

> Does simplification mean lowering of standards? If it does, it will do no good; for while it may produce less failure, it will bring about more holding back of the bright pupils. A radically simplified curriculum should not, however, result in a lowering of standards. Its very meagreness should serve to emphasize the fact that additional work is essential. It allows more time to be devoted to this additional work, and more adaptation of this work to the individual needs of the pupils. . . . Properly interpreting its [simplification's] advocates, then, simplification does not mean less work for anybody. Primarily it means simply different work for the less able and the more able children of each grade with a consequent reduction in the amount of work in common.

The advocacy of the complete elimination of highly complex and abstract materials from the sub-college levels for all students is gaining momentum daily among most educators who stress the basing of the curriculum on the needs evidenced in surveys of the daily lives of persons who are not specialists in certain fields. If the majority of these students will have no use for such complex and abstract materials as adults, and since they certainly have no use for it as children, the rate of forgetting even after painful and time-consuming drudgery will be inordinately high and thus the effort will be definitely not worth the time spent. It becomes increasingly educationally sound, then, not to burden these low-ability students with materials beyond their needs and capacities for comprehension. As is later noted, proficiency with the fundamentals wakes up most of the immediate and potential personal and social needs in mathematics for this group of students. Simplification of materials, then, becomes not only expedient but educationally intelligent methodology, and is subscribed to by many writers.[12]

Special help.—A third widely-commented upon and generally advocated methodology for rendering the program more flexible in terms of the capacities and needs of the low-ability student is the emphasis on affording him special, individualized help or coaching. This procedure, of course, involves and implies a number of universally favored methods which are also efficacious with normal and brilliant students. Among these may be mentioned educational and vocational guidance and supervised study which are more fully discussed in the next chapter.

More specifically with regard to special coaching, writers on the subject stress the point that this method of providing for individual differences is one of the most effective as demonstrated in controlled experiments. Maximum efficiency necessarily requires as intimate and exact a knowledge of the weaknesses of students as can be obtained by means of the fullest possible combination of evaluation techniques. Small classes are generally advocated for low-ability groups. In large classes, where special tutoring is almost a physical impossibility, personal and pointed suggestions during home-room periods, supervised study periods, study halls, after-school coaching, special coaching days, etc., may serve to accomplish partially its objectives. Those who object to small classes because of high administrative costs may well consider the

[12] See references 32, 36, 55, 66, 78, 86, 100, 110, 118, 123, 126, 127, 130, 150, 204, 208, 299, 300, 305, 312, 330, 335, 340, 356, 385, 390, 402, 405, 413, 432, 435, 440, 466, 479, 480, 482, 491, 504, 557, 583, 585, 592, 594, 595, 604, 619, 634, 657, 663, 664, 669, 691, 694, 702.

money saved by such procedures in the reduction of pupil failures and repeaters, to say nothing of the invaluable psychological benefits of success for the child.

Such added attention and aid is usually not only helpful to the student scholastically, but it also serves to encourage him and bolster his confidence provided the aid is given understandingly and sympathetically. Special tutoring must not merely help the low-ability student with certain scholastic deficiencies; it must also meet as many as possible of the social and emotional factors involved in the background of the maladjusted child. The intimacy attainable through special coaching makes the alert educator much more than the mere teacher (in the narrow sense) of the retarded child; it makes him his friend, his counselor, and his confidant.

It is important to remember that no matter how flexible one may make his curriculum or grouping arrangements, there will always exist a wide variety of abilities, many of which can be remedied only by special coaching. The important thing for the teacher is to make the very most of the time he can devote to such tutoring. He must know where the difficulty lies and how to make the student realize and comprehend what his particular difficulty is, to help him find the proper solution of this difficulty, and to provide him with practice and review materials with which he may go on by himself with a minimum amount of further special help. Numerous authorities[13] have advocated special coaching and others have implied it in their endorsement of such methodologies as supervised study, unit and project plans, and educational and vocational guidance.

Unit plans and class projects.—A fourth generally advocated means of making the curriculum more flexible to make allowances for individual differences is the shaping of the materials presented in terms of unit or contract plans, such as the well-known Winnetka, Dalton, and Morrison plans, or the planning of work within subject-matter areas in terms of projects. These plans offer distinct advantages even within homogeneous groups (which at best can never be entirely homogeneous) for continuous and cumulative educational experiences for children according to their individual capacities, and are recommended by many authorities.[14] Such devices largely do away with retardation, by allowing the student to continue from year to year from the point at which he left off the preceding school term, as well as with the waste of time and effort involved in the repetition of a whole grade by a student who fails to measure up to certain stiffly-administered arbitrary standards.

Projects imply much that is advocated by those who foster the integrated core-curriculum and similar methodologies. Both the project and unit plans are so designed as to capitalize as fully as possible on the native drive in children for activity, the desire to be doing things in terms of their interests, tastes, and abilities. This is particularly

[13] See references 8, 30, 46, 78, 80, 81, 100, 126, 127, 133, 160, 177, 189, 280, 299, 300, 316, 333, 362, 435, 457, 486, 539, 566, 588, 594, 616, 634, 664, 669, 694.

[14] See references 1, 56, 72, 110, 126, 127, 129, 152, 161, 182, 190, 222, 230, 262, 299, 300, 306, 311, 316, 333, 340, 382, 388, 390, 394, 396, 397, 399, 416, 421, 430, 440, 441, 453, 530, 531, 549, 550, 557, 634, 643, 644, 650, 654.

significant with regard to low-ability students whose love of doing concrete things manually offers teachers a rich field in which to work. Specific projects, such as setting up stores for buying and selling transactions, building model cities, running a post office, and the like, give children in general, and the low-ability student in particular, an opportunity to engage in busy activity and to use that excess energy.

The use of the project method and unit plans also tends to make the learning situation more meaningful to those experiencing it, facilitating proper motivation which is of particularly vital importance with low-ability students. As Ingram (299) puts it, these methodologies allow for outcomes judged in terms of "life activities" rather than in terms of subject-matter achievement. Where homogeneous grouping is difficult to administer or inadvisable for other reasons, these devices allow for both class and individual effort on the achievement level of each member of the class. Both facilitate the attainment of the objectives of the widely-advocated activity program. When many varied units and projects are engaged upon, they provide the novelty so necessary in the teaching of low-ability students. In various subject-matter areas, projects may be introduced which will involve practice with mathematics. In the English class it may be the measurement of material to make up the costumes of the characters in a historical novel. In the history class it may be the arithmetic needed to build a model of a Roman catapult. In the home economics class it may be the number experiences involved in the recipe for some muffins. In each case are included repeated and fundamental contacts with the mathematics which is usually pounded into pupils by means of sterile, meaningless drills and reviews. Such activities are contributory to the vital necessity, in education, for breaking down the conventional pigeon-holes of formal presentation and thinking in terms of lifelike wholes instead.

Other advantages of such methodologies as we have just noted, as well as of unit plans, may be listed as follows: (*a*) they increase efficiency; (*b*) they provide an abundance of meaningful busy work, (*c*) they increase accomplishment, (*d*) they provide incentives, (*e*) they minimize disciplinary problems, and (*f*) they offer an equal and fair opportunity for participation by all on the level of their individual abilities.

More flexible means of reporting progress and making promotions.—A fifth and final major means of facilitating flexibility to provide for individual differences is the emphasis on reform in the methods of reporting the progress of students and on breaking down the rigid and arbitrary standards governing the operation of retardations and promotions in the conventional school setup. With regard to the low-ability student in particular, the vast majority of writers[15] on the subject are in agreement concerning the malevolent psychological, emotional, and educational effects of continuous failure upon the child. This is especially true concerning failure in the early grades of the elementary school, when the pupil is just beginning his formal education. Some

[15] See references 14, 25, 46, 55, 80, 101, 175, 189, 211, 212, 213, 236, 244, 290, 312, 315, 340, 377, 396, 432, 478, 546, 571, 634, 638, 650, 702, 706.

writers have advocated pre-primary orientation classes to avoid the destructive experience of early failure. European countries, Russia in particular, have made great strides with their infant and nursery schools in this direction; and in this country we have the beginnings of these pedagogical advances, though at present they are mainly in the form of small private enterprises.

There are many writers,[16] too, who stress the vital necessity for the introduction of a more flexible system of grading and promotion in general. Many of them specifically describe new-type report cards and methods of advancement which have been used with relative success and which make for a more continuous and cumulative educational experience.

In addition to these may be added the writers noted in the preceding section who advocate various unit plans such as the Dalton, Morrison, Winnetka, McDade, and similar administrative devices, among the main objectives of which is the breaking down of the traditional, rigid methods of grading and promotions. This chorus is swelled to still greater proportions with commentary and evidence relevant to this matter by the writers[17] who emphasize the educational necessity for nurturing, especially within low-ability students, the growth of a sense of pride and confidence in their school work. This can be attained only by rewarding the success of the pupil's efforts. Since controlled experiments have repeatedly shown that pupils achieve more when working with knowledge of results than when working in the dark, pupils should be informed of the success of their efforts as soon as possible, especially if the results are favorable.

Such educationally desirable reactions as interest, motivation, and a maximum expenditure of effort are decidedly discouraged if not entirely obliterated by continuous and hopeless failure. The use of incentives and rewards for students who compete with their own records as well as with the achievement of their fellows on their own level is also widely endorsed in the literature. Many educators have conducted experiments on the importance and value of incentives and rewards and have published the results of these investigations.

We may at this time summarize some of the major and most generally agreed upon points concerning the need for flexibility in methods of reporting progress and promotions and concerning the involved matters of rewards and punishments and their educational implications. There would be no failure, it is generally noted, if administrators, teachers, and others controlling the operation of our educational systems had not set up a type of organization that makes grade repetition inevitable. Most conventional setups prescribe failure for the low-ability student by their intrinsic nature of stiff, arbitrary requirements and standards

[16] See references 5, 17, 25, 56, 79, 100, 103, 110, 126, 127, 160, 170, 171, 177, 238, 240, 244, 250, 269, 296, 299, 300, 311, 330, 335, 341, 355, 370, 379, 397, 398, 404, 435, 437, 467, 477, 479, 480, 481, 486, 535, 536, 562, 588, 594, 632, 644, 664, 691, 700.

[17] See references 19, 21, 26, 48, 53, 55, 59, 62, 63, 66, 76, 78, 85, 87, 100, 133, 135, 137, 154, 177, 202, 207, 211, 212, 214, 224, 237, 250, 299, 300, 304, 308, 311, 312, 316, 319, 329, 330, 332, 333, 334, 338, 340, 357, 366, 375, 376, 382, 390, 395, 396, 397, 404, 410, 412, 413, 448, 471, 482, 485, 491, 518, 543, 557, 566, 585, 594, 595, 604, 613, 616, 634, 639, 650, 680, 694, 703, 707.

regardless of the abilities, interests, tastes, and needs of the individual student in hand. In most cases, where the fault lies chiefly with the school as contrasted to environmental and hereditary mental and physical factors, the school organization rather than the individual teacher seems basically responsible for most failures. Ungraded class systems and similar devices have found widespread approval in much of the literature on the subject, especially with regard to hopeless cases of low ability. Even ungraded classes and homogeneous groups should never be marked with the stigma of dullness, for this may, in itself, defeat the entire purpose of grouping. Broad ultimate goals in terms of the capacities of individual students should be the framework within which progress is measured, and allowances should always be made for the maximum use of school time by the provision for the fullest possible continuous and cumulative growth of the child.

All too frequently repetition of a grade means simply the repetition, for the student, of exactly the same educational experiences which caused his earlier failure. Besides the fact that such a procedure is a waste of time, the detrimental psychological effects on the student are immeasurable. It is essential that the student be able to see that he is making progress at all times in his work at school. It is doubly essential that he be aware of progress if he is repeating work which he has done before. Materials presented must be made meaningful *for him* and must be presented in a variety of ways.

Among the most generally advocated means for limbering up the system of promotion, aside from the use of such devices as homogeneous groupings and the use of ungraded classes, are such devices as the shortening of promotion intervals, multiple-track plans,[18] parallel sections plans, parallel program plans, the promotion of students by individual subjects, trial promotions, and the lessening of the amount of work to be repeated by failing students. Educators have also recommended a "primary" unit, which would include the work from the kindergarten through the third grade and act as a "shock" or orientation unit for children in the highly formative first years of formal schooling.

In addition to these, the fullest possible consideration of a pupil's assets, aside from scholastic achievement, should be considered in the matter of promotion, and the child should be given every possible benefit of doubt. There should be more value accredited to such characteristics as coöperativeness, work habits, industriousness, leadership (for even in a homogeneous group of slow students leaders *will* emerge), growth of personality, intelligent self-direction, social adjustment, ability to reason and generalize, etc., which are coming in for more and more attention on various new-type report cards. Report cards which, instead of offering arbitrary grades, present a brief commentary to the parent on such characteristics as those just listed are being more and more favorably reported in the literature. Achievement by pupils in the light of their capacities and needs instead of in time spent in certain grades must become the constant factor in our educational thinking. This needed change becomes increasingly significant in the light of the

[18] Such as the Elizabeth and Cambridge plans.

already noted widespread confusion concerning the whole matter of readiness and placement.

The continuous and cumulative intellectual, emotional, and physical growth of the individual student, rather than arbitrary, predetermined standards, should be the measure of success or failure. Paralleling such changes there would necessarily have to be a substitution of a sequential organization of subject matter for the conventional graded organization of such material. Here again, we would run into the maze surrounding the matters of placement and readiness which sequence implies and involves. But, nonetheless, numerous logical schemes have been presented which are at least an improvement over the rigid graded organization of the conventional school setup.[19] Such arrangements may allow more fully for growth in terms of interests, attitudes, and habits of work, as well as in terms of subject matter.

The general consensus among the writers on the subject, in noting all of the above points, is that the retardation of students is very seldom an effective educational practice and that it usually serves no useful end, especially with regard to students in their early educational careers. Reform in the matter of administering promotions must be accompanied by a reform in the matter of marking systems and the methods of reporting to parents. As Worlton (700)[20] sums up this point:

> The tendency of progressive schools during the past decade has been decidedly in the direction of an all-inclusive program which sponsors the total personality development of the individual pupil, including, in addition to the fundamental tool subjects, the desirable habits and attitudes which make for character and citizenship. This broader program of the schools should be reflected in the report card, which is the official method of communication between the home and the school. Unless reform in the report card is made, a countercurrent of marked influence may be affecting negatively the character traits of children.

Such, then, are the general methods which are widely commented upon in the literature concerning the need for rendering curriculum, materials, administration, and teaching methods more flexible in terms

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[19] An example of such a sequential organization is the one offered by J. C. Morrison, in an article entitled "Can We Adapt Arithmetic Instruction to the Needs of All Children?" which appeared in *The Mathematics Teacher* 31:373-8, December, 1938. The example is as follows:

"Counting, reading and writing numbers.
Addition and subtraction of whole numbers.
Multiplication and division of whole numbers.
Measurements.
Fractions.
Decimals, percentage, and related topics.
Geometry.
Algebra.
Problem development."

In such an arrangement Morrison points out (*a*) that each category is developed in logical sequence, (*b*) if a pupil is troubled with a certain problem, the teacher may turn to the treatment of the category in question and determine the steps that the student should have mastered in leading up to the stage where his particular difficulty lies, (*c*) this allows for pupils working in the same class on the same problem or on a general topic but at many different levels of achievement.

[20] Worlton, J. T. "Shall We Eliminate the Comparative Marking System from the Report Card?" *Elementary School Journal* 33:184, November, 1932.

of the interests, tastes, abilities, and needs of the individual students who make up the low-ability group. We may now proceed to a number of general methodologies which are widely advocated and which supplement the methods already noted in this survey.

CHAPTER V

GENERAL METHODS

From this point forward, it becomes impossible to say that one method should precede or follow any other which is advocated. All impinge integrally and inextricably one upon the other. It is rather by a combination of all the measures which are described, in addition to such techniques which any individual teacher may himself have perfected for the solution of immediate, specific problems which he has faced, that the fullest possible development of the potentialities of the low-ability student may most likely be realized.

Proper Motivation and Real-Life Situations

Among the most universally emphasized points in the literature is the exhortation that the materials presented to students in general, and to the low-ability student in particular, should be closely geared to the daily, real-life experiences of the children themselves, both in contact with their fellows as well as with the adult world in which they live. The literature stresses that the work presented must be made meaningful to the group as a whole, as well as to the individual within the group. This is particularly necessary for the low-ability student who frequently has both a short attention span and a poor memory. It becomes doubly important, then, to motivate the work so that his interest will bolster his attention and to provide him with material steeped in reality. The specific before the general, the concrete preceding the abstract,[1] the practical anticipating the theoretical, always adequately motivated and grounded in real-life situations—such must be the order of presentation for the low-ability student.

The use of such materials capitalizes on a basic methodology which is equally relevant for all students; namely, to begin with the student where one finds him, and to develop to the maximum the educational possibilities of all of his daily experiences in and out of school. In the early years of the elementary school this means making the most of the wealth of educational experiences with which the child has incidentally come into contact before beginning his formal schooling. The isolation of information concerning such activities and experiences is one of the main functions of the evaluation program. Such information, bolstered by the results of researches in the field,[2] provides the teacher of even the first-grade student with a rich mine in which to work for the greatest possible benefit of that student.

The natural interests and curiosities of the child, when properly used, are ever the most effective tool in the hand of the alert teacher. The child is usually brimful of energy and vigor, and when

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[1] As Goddard (238) has noted, "everything is abstract for them [those of low ability] that does not concern those things which enter into their daily life and experience."

[2] See Brownell (92), p. 80.

the teaching is moulded in line with his native love of play and propensity for constant activity, the subject matter assumes new and pregnant meaning and in this way becomes assimilated as formally, pounded-in indoctrination never can. Such teaching would, of necessity, involve much integration of activities with the presentation of what may well be barren subject matter. Achievement and success should be measured by the ability to cope with and solve real-life problems rather than by dexterity in academic verbalizing and linguistic accomplishment. The utilitarian aspects of education for the low-ability student must ever be a prime consideration in order to prepare the student more adequately for his entry into the industrial world and to eliminate the tragic sense of failure with which so many of these pupils now enter life after buffeting years of enforced educational experiences beyond their ken and possible needs.

The important thing to teach is not what the pupil can learn by such devices as rote memorization and incessant, sterile drill, but what it will pay him to learn in terms of his immediate and future personal and social needs. Repeatedly, authorities like Wilson, Bobbitt, and Woody have stressed the fact that the reason for a large percentage of failure, especially in mathematics, is that subject matter is included which has little social value and is far removed from the daily-life experiences of the students involved. To the low-ability student, in particular, realistic and meaningful material should be taught to the point of complete mastery. Repetition of such materials in an endless variety of guises is not wasteful if the desired mastery is achieved, for, though the amount of ground covered may thus be limited, the material presented excludes much of the chaff for which such pupils will probably have no use. This is true educational economy.

Such real and meaningful materials have repeatedly been shown to contribute definitely to student success. The dynamic factors of motivation and need, as Brownell (92) points out, are inherent in the whole matter of readiness, which plays such a large part in success. With regard to mathematics, this means the planning of situations and activities involving the maximum amount of number situations which grow naturally out of the individual student's personal and social environment.[3] Such an arithmetic program, incorporating the basic arithmetical steps of any grade, may be undertaken with considerable assurance that these steps will be mastered. It would make allowances and give credit for out-of-school projects on which students may be engaged. Day by day situations in terms of broadly planned projects instead of rigidly prescribed regimens would be the necessary vehicle for such a plan.

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[3] See references 2, 4, 11, 13, 19, 22, 23, 24, 32, 36, 42, 47, 48, 53, 55, 61, 65, 66, 69, 70, 72, 78, 80, 82, 86, 91, 92, 94, 96, 100, 105, 110, 111, 112, 117, 118, 126, 127, 130, 138, 140, 142, 149, 150, 151, 153, 155, 160, 163, 168, 176, 177, 178, 183, 185, 189, 190, 204, 211, 218, 221, 227, 230, 238, 250, 260, 262, 263, 267, 274, 275, 278, 286, 287, 288, 291, 293, 296, 299, 300, 301, 306, 311, 312, 315, 320, 321, 330, 333, 334, 338, 340, 342, 348, 349, 352, 353, 355, 356, 358, 364, 366, 371, 373, 382, 385, 387, 388, 389, 390, 393, 396, 397, 398, 399, 402, 405, 408, 409, 413, 416, 421, 425, 430, 433, 435, 440, 441, 442, 443, 444, 453, 459, 461, 465, 466, 467, 471, 482, 484, 486, 487, 489, 491, 501, 502, 504, 512, 514, 515, 516, 519, 521, 524, 531, 538, 542, 543, 544, 550, 553, 554, 556, 557, 568, 583, 585, 589, 592, 594, 595, 598, 602, 604, 611, 614, 615, 622, 626, 627, 634, 639, 641, 643, 646, 647, 649, 650, 651, 652, 656, 663, 668, 669, 670, 674, 679, 680, 682, 683, 684, 685, 687, 689, 691, 692, 694, 695, 701, 702, 703.

According to Eisner's (204) suggestion, such a program might eliminate from the upper levels such aspects of the mathematical program as all formal and demonstrative geometry, and most manipulative algebra, with algebra taught only as a tool for solving useful problems. On the lower levels, the program would center around the fundamentals which have been repeatedly shown to have the greatest utilitarian value and on those which are the source of most error in the later courses dealing with number. The emphasis on the tool aspects of arithmetic would be in relation to such activities as buying and selling transactions; counting games, rhymes, and jingles; reading numbers on clocks, houses, lockers, calendars, book pages, box scores, thermometers, hooks in halls, railroad tables, tickets, etc.; measuring height, weight, foods in recipes, cloth in sewing, boards in industrial arts, etc.; playing games; developing such projects as post office, rummage sales, stores, gardens, nature study, etc.; participating in school activities involving number such as preparing for plays, athletic contests, music festivals, etc.; and taking part in countless other similar activities which are plentifully listed and described in the literature on the subject.

Concreteness of Presentation

A second method generally stressed in the literature is that of making the materials presented to the low-ability student as concrete as possible.[4] Such a student may have certain intellectual failings, but he is generally very normal with regard to his physical perceptive and receptive senses. He enjoys and profits from seeing, hearing, smelling, and doing things rather than from hearing them talked about or from reading about them. His inability to grasp the abstract makes it necessary to make assignments and lesson presentations specific, concrete, and clearly understandable to the point of being self-evident. This involves the widest possible variety of presentation, which will exploit every means of appealing to every mode of concrete thinking whether visual, auditory, olfactory, or motor.[5] This variety of media may include such things as motion pictures, posters, art reproductions, drawings and diagrams, slides, stereoscopic views, graphs, and similar pictorial materials; radio programs; phonograph recordings; musical programs; models, costumes, decorations, etc. created by the students themselves; and dramatizations and games, etc., and should be chosen for the greatest appeal they may have for the greatest number of participants. Projects should be devised which will allow every member of the group to take a constructive part. Dramatizations should allow each student to make a contribution, whether as actor, stage designer, costume designer and executor, ticket seller, or what not. Pictorial materials should be made as colorful as possible, since researches have shown that such materials

[4] See references 8, 11, 24, 31, 32, 36, 46, 53, 55, 60, 65, 68, 78, 82, 88, 100, 123, 126, 127, 130, 135, 140, 150, 151, 155, 164, 178, 204, 208, 219, 234, 238, 250, 284, 286, 290, 291, 298, 299, 300, 312, 333, 340, 347, 357, 381, 387, 389, 390, 397, 409, 411, 413, 418, 432, 435, 440, 442, 446, 458, 459, 465, 466, 471, 482, 491, 495, 499, 512, 515, 519, 521, 524, 525, 530, 536, 540, 550, 553, 557, 558, 561, 583, 585, 591, 592, 594, 595, 622, 634, 639, 650, 658, 663, 668, 669, 674, 691, 694, 696, 703.

[5] Psychologists such as Boring, Langfeld, and Weld, in their *Psychology: A Factual Textbook*, have contended that there are no true motor images, only actual movements.

are more effective than ordinary black and white materials. All of the devices and activities described may be connected with mathematics by the alert teacher.

Direct, objective, oral presentation is preferable to a preponderance of silent reading and study. This will involve numerous activities in domestic science, physical education, and the industrial arts, wherein the mathematical implications involved in measurement, following recipes, keeping scores, and similar necessary number experiences that appear in real life. Concreteness necessarily implies practicality of materials and presentation.

The importance of visualization of the materials by the student who is confronted by them is especially necessary in mathematics. In failing to picture an arithmetic problem concretely, the child may give an answer which, in real life, he would immediately recognize as absurd. Mental arithmetic, especially in the early number experiences of the low-ability student, should be kept at an absolute minimum. Boys have been repeatedly shown to be the majority in retarded groups. It has also been amply demonstrated that they seem to have a greater ability in the manipulation of concrete things than their fellows of the opposite sex. Why, then, can't these two facts be educationally capitalized upon by allowing these low-ability boys the fullest possible number and combination of concrete, manipulative school experiences? The abstract nature of number must never be forgotten by the teacher. Even with more normal children, the mastery of such abstract conceptions, especially on the early elementary levels, is an exceedingly slow and precarious learning experience. The introduction of the abstract symbols called for in mathematics should be delayed until the instructor has fully achieved the basic development of the number sense in his students.

The stress on vocational or pre-vocational training must not, however, become the dominant stress in the training of the low-ability student. Subject-matter presentation, whether academic or in industrial arts and similar fields, must not always be related to concrete situations, since the student's judgment and powers of abstract and creative thinking must be developed as fully as possible. Any emphasis on vocational or pre-vocational training must be considered secondary to this.

In the development of these primary educational objectives, one cannot overstress the necessity for providing for a continuous and cumulative learning experience proceeding from the simple to the complex, from the known to the unknown, from the oral to the written, etc., by a carefully planned series of gradual, logical, and meaningful (to the students) transitions. And that which *is* meaningful to the usually practical mind of the low-ability student is always that which is concretely presented and which, to him, has a multitude of concrete applications. Reid (519), in her study of the incidental number situations in a first grade class, noted that 514 cases involved concrete social situations while only 64 were of an abstract nature. The immense wealth of real-life situations embellished by the concrete offers no excuse for burdening the beginning student with the abstract, the unfamiliar, and the disillusioningly incomprehensible. The premature memorization of abstract number facts and combinations may well

lead to serious later handicaps, to say nothing of the immediate waste of time and effort which they necessarily incur. Numerous readiness studies have stated that it is not likely that even normal first and second graders are mature enough completely to master isolated addition and subtraction facts, and they indicate that formal work such as drill and book work over these facts should probably be discouraged until the third grade.

Even when formal work is begun, perhaps in the third year, the procedure should ever be from the concrete to the abstract, and with low-ability students the concrete should always be the dominant presentation. In this way the most can be made of the wealth of concrete number experiences with which the child enters school as a result of his preschool conditioning. Logical, creative thinking, with its attendant abilities for generalization and association, are inextricably dependent upon a rich store of concrete experiences even with the most brilliant students. The direct association between concrete materials and abstract symbols must be repeatedly pointed out, especially to the low-ability student; the instructor must not become lost in concrete instances, as Myers (446) has pointed out. The learner must always be led in safety and surety, from the concrete to the principle involved. Formality, in the Buswell sense of pertaining to anything in content or method which is presented without regard for the meaning which it has for the child, must be eliminated, and the informal which abounds in the use of the concrete should be substituted.

Variety and Novelty of Presentation

A third method that is generally stressed is that of presenting subject matter through a great variety of activities and devices.[6] The short attention span of the low-ability student as well as his slowness in seeing relationships and making generalizations necessitates the repetition of instructional materials and methods to the point of overlearning. This repetition requires the complete ingenuity of the teacher in providing novel and meaningful ways of saying and doing the same things. It is imperative that the low-ability student be kept busy at some task which will require his full attention and capitalize on his eagerness to do manipulative tasks which appeal to his sensory perceptions and physical abilities. To this end, it is important to intersperse and integrate recreation, in the form of physical education, games within the classroom, or extracurricular activities, with the regular instruction. Again, such integration is perhaps most easily effected through unit plan presentations, projects, and core-curriculum procedures. If textbooks must be used, it is well to have them broken up into small units so that the child may enjoy the psychological pleasure of finishing one book and beginning a new one several times within the course of a school term.

Variety of presentation means not only presenting the same thing in different guises, but also presenting it from as many different com-

[6] See references 23, 53, 55, 65, 69, 78, 82, 94, 95, 100, 126, 127, 130, 140, 160, 161, 163, 183, 234, 250, 299, 300, 315, 340, 358, 389, 390, 405, 430, 432, 440, 471, 482, 491, 530, 557, 585, 595, 650, 663, 694, 702.

plementary and supplementary angles as is possible. Variety of method and materials is one of the mainstays of flexibility in general. Another danger to safeguard against is the idea that variety will automatically create constant and unabated avid interest. In the most richly endowed curriculum, fatigue must ever be carefully watched for and guarded against. This is especially true with low-ability students who generally tire more easily than more normal students. Similarly, variety is no automatic panacea to end parrot-like verbalizations which must be guarded against by making sure that the enriched presentation serves to enhance continuously and cumulatively the student's understanding of the materials in question. Variety, marked by the freshness of new materials, is necessary lest the student assume an air of contempt for that which has been done so often before. On the other hand, the large variety of new experiences and situations will necessitate practice with recently acquired skills and knowledges essential to fixing the habitual responses so necessary in many cases of low ability.

An enriched school program, marked by the variety described, will give each child within the entire educational setup an equal opportunity to go through the same cycle of experiences in accordance with his capacities and needs. Such a program will need a wealth of supplementary educational materials. Individual as well as group tastes, interests, and abilities must ever be the guide to the materials presented. A careful investigation of such interests should yield the teacher a wealth of leads to make the program as variable and constructively novel as possible. Such a basis for the variation of materials, plus such devices as that of limiting the time for doing a task, will help maintain the necessary maximum of attention. The abundance of illustration implied in the varied program must ever stress applications and the mastery of principles resulting from assimilation on the basis of repeated applications.

Stress on Accuracy

As has already been suggested, a fourth point of general stress in the literature concerning the low-ability student is the emphasis on the necessity for disciplining him to a maximum degree of accuracy in his work, and to as complete a mastery as is possible of certain minimum essentials (which in mathematics would be the fundamentals).[7] Guessing and haphazard methods of work should be avoided because with these students mastery depends to a very large extent on habit formation and automatic recall. Neatness and legibility are always to be encouraged and sought for as means to the end of accuracy. This is especially true with regard to the writing of numerals, the indistinctness or illegibility of which has repeatedly been demonstrated as a major source of error in mathematics. Speed with the low-ability student should ever be a controlled, secondary activity to be gauged entirely by the necessary accompanying accuracy without which speed itself is meaningless and invalid.

[7] See references 23, 66, 86, 94, 105, 111, 139, 140, 204, 300, 311, 340, 396, 397, 444, 447, 455, 471, 482, 556, 557, 570, 594, 595, 602, 604, 639, 663, 664, 669, 672, 680, 682.

According to Brownell (94), learning arithmetic by repetition results in greater proficiency and speed, while learning by insight results in better intelligence and understanding. The former objective is the primary one with the low-ability student. A general characteristic of this type of student is carelessness and lack of patience with things requiring concentrated effort. This is due for the most part, to his short attention span and his failure to see the relationships between things which may serve as a stimulant to more interest in some project. The stress on accuracy, in the light of this, becomes very important with the slow student, especially with regard to new and unfamiliar materials. Accuracy further requires of the teacher a painstaking attention to all of the minutiae of teaching with the low-ability student. Nothing may be taken for granted, and even the most obvious must be carefully and varyingly repeated until the fullest possible mastery is assured.

Since a minimum that stresses the most important essentials will be required of the low-ability student (in mathematics, this will be the fundamentals, primarily, with the addition of the few fractions such as those shown useful in daily life, some percentage, the decimals used in calculations concerning money, and similar skills and knowledges), the time necessary for repetition to assure complete accuracy in the handling of these essentials will not be a waste of time educationally. It seems more and more evident, in the study of general errors made in mathematics, that students often learn the fundamental processes in an irregular and erratic manner. Never must one of the arithmetic skills be undertaken until complete mastery of that which has gone before is achieved. One of the chief advantages of unit-plan presentation is the insistence upon mastery of one unit before another is attempted, so that, as far as possible, proper preparation for the ensuing work is assured.

Schorling (557), in his report of an experiment in Flint, has noted that the rate of forgetting with slow students does not appear so great after the pupil has been led to a high degree of mastery. Such a true mastery as is to be desired would be more than automatic; it would involve a feeling for accuracy and orderliness on the part of the student as well as an appreciation for the values of proof over argument. The mastery of the facts of arithmetic must be accepted by the child as his personal project if he is to achieve mastery at all. Incentives to achieve accuracy, such as competitions by the student both with his own record as well as with his fellows on his own level, continued stories, games, reproof and praise, parties, open-air play, etc., are generally advocated as means to this end, but with warning never to let the means become so dominant as to obscure and negate the end objectives. At all times repetition for the sake of accuracy should be in reality intensified learning experiences, and never must the variety and novelty of presentation induce the superficiality of learning which the technique is trying to obliterate.

Proofs and checking.—The teaching of proofs and checkings is generally advocated to the end of attaining as complete a mastery as is

possible.[8] A few such proofs as casting out nines are frowned upon by certain writers, but for the most part proofs for the fundamental processes are commended, especially when they involve the use of a second process to check the original one used. With regard to the controversy concerning the superiority of upward as against downward addition, many authorities suggest that one form should be taught as a check on the other. Such a writer as Renwick (521) even advocates the primitive faith in counting as a device for checking and advocates, especially on the early levels, more frequent use of counters and the abacus for reference and experimental work with number. Many writers advocate the provision of students with keys for checking their solutions as a means to allow more fully for individual differences in rates of speed. With low-ability students, the use of such keys would be largely dependent upon their maturity and ability to use the keys constructively, and not merely as an escape device. Proofs and checking, however, it should be noted, do not necessarily guarantee accuracy, as Grossnickle (249) has pointed out. Again, these devices must be used only as a part of a whole methodology of which no single part alone may be expected to gain maximum results.

Short cuts and crutches.—On the other hand, the use of short cuts and crutches is generally discouraged, especially with the low-ability student to whom they will usually become a source of confusion or an inadequate escape device.[9] Some more obvious short cuts, such as cases involving the zeros at the end of the multiplier, may be taught with some degree of success without the danger of creating an unwarranted degree of confusion in the mind of the student. In the actual teaching of certain processes, short cuts may be used as a motivating device. This may be carefully used to advantage in the introduction of multiplication as a short cut to addition. Certain empirical educators advocate the use of crutches on the basis of effectiveness. This may be well, provided that the immediately observable results are not really undermined by far more harmful although subtle destructive undercurrents. In all cases, crutches and short-cuts must be very carefully examined for all their possible implications in the light of individual capacities and needs before they are used. A short cut, to be mastered, must become habitual with the student, rather than used only on the teacher's direction.

Drill and review.—Another universally stressed method for training the low-ability pupil in accuracy is the advocacy of constant review and drill, much of which will effect automatic habitual responses. Such reviews and check-ups, supported by remedial as well as regular, well-motivated drill, should be frequently administered on the basis of the carefully recorded and charted results of a well-planned testing program. It may be most expedient, at this point, to summarize the most widely-stressed points regarding the well-administered program of drill

[8] See references 100, 139, 161, 247, 249, 288, 299, 300, 340, 390, 397, 454, 521, 604.

[9] See references 65, 90, 300, 340, 604, 668.

and review, especially since they are related to the low-ability student and as they are generally noted in the literature.[10]

1. Drill must ever be properly motivated and thoroughly varied to maintain a maximum pleasurable interest on the part of the student. It should always be in terms of the social problems in which the specific operations function. Games are frequently an effective means to this end.
2. Drill should ever be in terms of the demonstrated needs and shortcomings of students as evidenced in the results of a comprehensive testing program. It should be thoroughly individualized since it is quite possible that there is no one drill that is equally adaptable to any considerable number of pupils. Promiscuous drill may cause students not needing it to mark time without profit, or to decline in ability because of it. It is important to remember that variations in ability among students are being constantly increased rather than decreased as the result of class drills.
3. Distributed drill should be provided over all of the individual processes involved in some situation necessitating one or more fundamental processes before drill is given on the more complicated encompassing number situations; that is, it should include every step in a series. Distributed drill is interpreted as meaning that all the number combinations used in a process should be present in drill upon that process and that the constituent elements of each function should be given due amount of practice. Each drill unit should be a mixed drill.
4. Provisions should be made for drill over any new step in all subsequent lessons to ensure, as far as possible, the maximum retention of the new learning experience.
5. Reviews and drill should help to facilitate and be in line with the continuous and cumulative growth of the student's varied capacities.
6. Drill and review should capitalize on the various researches concerning typical errors, and should capitalize on these leads instead of overlooking them.
7. Drill may deeply impress bad habits as well as good ones and must therefore be carefully chosen in terms of clearly defined objectives.
8. Drill and review materials and presentation should ever be as concrete as possible, especially in relation to the highly abstract conceptions concerning number.
9. Students should be given speedy and full information concerning the results of their drill and review work.
10. Time for drill should be provided whenever and wherever the need is reasonably demonstrated. It should never arbitrarily be inserted in any curriculum unless the need actually exists.

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[10] See references 2, 4, 16, 19, 23, 24, 32, 34, 36, 40, 47, 52, 53, 55, 61, 65, 72, 82, 86, 91, 92, 95, 100, 103, 105, 110, 111, 118, 120, 126, 127, 130, 137, 140, 147, 148, 162, 173, 174, 176, 177, 178, 182, 183, 204, 208, 222, 224, 243, 250, 273, 278, 280, 288, 291, 298, 299, 300, 312, 315, 324, 334, 336, 337, 339, 340, 342, 343, 347, 364, 387, 389, 390, 396, 397, 398, 402, 405, 409, 413, 422, 431, 432, 435, 438, 440, 441, 443, 447, 449, 450, 451, 453, 466, 471, 473, 482, 486, 491, 492, 494, 496, 517, 534, 535, 536, 540, 550, 556, 557, 570, 577, 583, 585, 589, 595, 604, 619, 633, 634, 635, 643, 644, 649, 652, 663, 668, 669, 672, 680, 682, 683, 692, 694, 706.

11. Short drill periods are usually most effective. Most studies indicate that this should not exceed five minutes at the outside. This is particularly true of the low-ability student with his short attention span.
12. The time span between drill periods should be very short at first and gradually lengthened as the knowledges and skills gained become more permanent.
13. Drill and review should primarily be aimed at accuracy rather than at speed, which depends largely on maturity. Speed, however, is to be desired to the point of making the student's performance as effective as possible.
14. Extensive drill should not start each new school period following a vacation. It should be given only after evidence of the need for such work is demonstrated; that is, it must ever be on a functional basis.
15. Drill must ever be within the ready comprehension of the students involved; that is, it should be over materials already introduced by regular instruction.
16. In drill and review the distribution of the repetitions is far more significant than the mere number of repetitions involved.
17. Answers called for in drill work should be individual. Collective answering is deceptive in that the large number responding is no indication of the number actually thinking or benefiting from the activity.
18. Drill should promote efficient habit formation aimed at an identical reaction with a minimum of variation, and should prevent the occurrence of exceptions to the desired habits.
19. Drill as a means to mathematical thinking should ever be kept in mind, and drill of and for its own sake alone should be discouraged. Mechanical drill never will develop the insight in number essential for success in mathematics.
20. Drill should provide for frequent applications of the principles involved.
21. Provisions should be made for an adequate amount of self-administrative drill devices and materials.
22. The greatest time allotments should be made for drill and review over known typical areas of greatest difficulty, and over individual areas of maximum difficulty as demonstrated in the testing program.
23. Drill work should make the most of incentives like competition by the student, with his own record as well as with the records of his fellows on his own level.
24. Drill work should be kept at a minimum in the first two years of the elementary level with a major emphasis on the gaining of broader and more fundamental understandings of the problems of real life and on the development of the number sense on the basis of the preschool number experiences of the students.
25. If textbooks are used, drill procedures should be adapted to the needs of the individual texts being used in terms of the demonstrated individual needs of the students.

26. Careful analysis should be made of the function of a skill or knowledge which is the object of drill or review and the work should be planned in accordance with such an analysis.
27. Drills should have time limits, but not so stringently rigid as to cut off drill when the demonstrated needs of the students show that more drill is required.
28. Drill work should have accuracy standards.
29. Drills should provide for a continuous diagnosis of the difficulties of individual students as well as of the entire body involved.
30. Drills should make provisions for retesting following a remedial program based on the results of a comprehensive testing program.
31. It is important to remember that, as the difficulty of a task increases, the amount of individual differences increases proportionately, and due allowance should be made for these as the drill work covers more difficult materials.
32. Drill should allow for only one correct response, requiring exact reproductions with only complete accuracy acceptable.
33. The threefold objectives of drill, as Myers (449) has put it, should be assimilation, skill-building, and skill-holding.

Supervised Study

A fifth general point of stress in the writings concerning the teaching of the low-ability student is that advocating a constructive program of supervised study.[11] Low-ability students, with their generally inferior ability to see associative connections and to generalize upon the basis of past learning experiences, are particularly in need of specific supervision in methods of study. This becomes all the more evident when, throughout the literature, repeated emphasis is made of the fact that unreasonably large numbers of normal and even brilliant students fail to achieve in accordance with their capacities because they do not know how to study correctly. In arithmetic, specifically, such instruction would involve teaching students the best known techniques. Such a program of supervised study would aim at bolstering and strengthening the generally noted intellectual weaknesses of low-ability students. It would consciously strive to encourage individual work, to teach pupils to make discoveries for themselves and to see the associative connections necessary for such individual initiative and its resultant rationalizations and generalizations, to develop their insight and powers of self-analysis, etc.

The program of supervised study would further entail a well-planned home-visitation schedule, either by visiting teachers or by regular teachers, in order to improve relationships between the home and community and the school and to facilitate the maintenance of more ideal home-study conditions.

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[11] See references 6, 9, 11, 23, 32, 55, 73, 77, 78, 94, 100, 105, 111, 118, 128, 140, 146, 160, 161, 168, 201, 208, 225, 239, 255, 274, 280, 288, 289, 294, 299, 300, 340, 387, 390, 396, 397, 398, 402, 407, 413, 416, 420, 432, 435, 444, 471, 474, 482, 486, 491, 504, 516, 535, 536, 553, 556, 557, 564, 565, 569, 570, 575, 576, 592, 595, 604, 613, 623, 652, 663, 667, 668, 669, 702.

Supervised study, in order to be effective, must be in the hands of alert teachers who, on the basis of personal observations and the results of the testing program, can get to the seat of a student's individual difficulties in a minimum amount of time and offer personal suggestions and methods to alleviate and remove those difficulties. Certain basic and generally applicable principles of effective study methods may be most economically imparted to homogeneous groups as groups. However, there will always be the need for personal and intimate advice on this matter with regard to the individual differences which will inevitably exist. The amount of time given to the individual student in teaching him effective study methods must ever be in relation to the rate of speed with which he is able to learn. Teaching the student how to study is as much the teaching of a skill as is teaching him how to manipulate the number facts learned in a multiplication table.

With regard to the low-ability student, the writers on the subject are generally agreed that supervised study periods within the regular school day and under the careful eye of alert and well-trained teachers are preferable to home study with all of its attendant evils. A large percentage of the students in the slow groups come from undesirable home environments, where conditions for study are extremely unsatisfactory. The low-ability student, under such handicaps, without careful direction is likely only to entrench more deeply the bad study habits by which he is already more than beleaguered in his large dependency on habitual reaction as a substitute for creative thinking and personal initiative.

Where the school does not provide periods of supervised study for the low-ability student, individual class teachers should take part of the regularly assigned class period for such activity. Home study, with its advantages of stimulating independent attacks on problems, is largely wasted upon the low-ability student until he is ready and capable of undertaking problems dependent upon individual initiative. Besides encroaching on the leisure time of the pupil, home study frequently encourages undesirable habits of dishonesty, as the student is more apt to submit work that is not his own.

If home study is at all desirable it should be moulded along the student's outside interests and should be so highly motivated that the student will be eager to do the work. More and more, controlled experiments have shown that pupils in general and low-ability students in particular achieve more under supervised study programs where home study has been abolished. Physiological considerations, furthermore, indicate that home study, especially at night, is far less desirable than supervised study during the regular school period since the child is exhausted and less receptive to formal learning at the end of a long day. Most writers, however, do not favor the complete abolishment of home study. Such assignments may be made very effective and constructive in the wise choice of materials and tasks involved. In arithmetic, the general consensus is that there should be very little if any home work assigned, and this is particularly true in the case of the low-ability student.

Innumerable lists have been drawn up on points to be brought out in teaching students how to study. It may be well to note, at this point, some of the most widely commented upon items. The student should be taught the importance of reading and rereading, sentence by sentence, if necessary, the materials presented to him. This is particularly true in arithmetic problems where a high correlation exists between ability to read intelligently and ability to work the problems involved. The student should be taught how to discriminate between meanings, isolating the important from the less important in the materials confronting him. He must be able to translate the facts and relationships in the materials under observation in terms of his own vocabulary, experiences, and understandings. He must be able to understand the meaning of abstract symbols, which play such a large part in mathematics, as this is the only guarantee against empty, mechanical manipulation which so often passes for laudatory achievement.

In problem materials means should be taught the student for tackling the important issues by finding out what is stated, what is missing, and what is to be found out in terms of these two quantities. Habits of making diagrams or drawings to represent some given situation and to help make abstractions more concrete should be developed. Habits of estimating answers and being able to tell the reasonableness of such estimated answers are worthy of careful inculcation. The habit of checking results should also be fostered. Means for maintaining maximum attention may be pointed out. Methods should be emphasized for committing to memory, as economically as possible, certain things which *must* be memorized. Definite goals should be set up by students in arranging their course of study. These latter four points are of particular importance for the low-ability student, for slow students are frequently characterized by their aimlessness in tackling specific problems. And, finally, to complete this indicative rather than exhaustive list, students should be versed in the methods of preparing for and taking examinations.

Keeping Student Happy and Satisfied

A sixth point of general stress in the literature is the need for understanding the student and keeping him happy and well-satisfied.[12] This matter is of exceptional importance to the low-ability student, with whom learning in terms of habit and automatic recall plays such an important role. Probably the prime requisites in making the work pleasant and satisfying to the pupil are a flexible and intelligent program based on the individual interests, tastes, abilities, and needs of the student and the administration of such a program by an alert, well-trained, patient, and understanding teaching and administrative staff.

The low-ability student must never be made the butt of teasing or ridicule. It is vital to buoy up his confidence and spirits at all times by giving him every chance to experience success and contribute con-

[12] See references 21, 23, 66, 103, 110, 131, 164, 176, 177, 211, 212, 234, 245, 308, 312, 332, 369, 390, 413, 507, 557, 566, 583, 584, 594, 634, 643, 680, 694.

structively, to the extent of his capacities, to the whole school life of which he is a part. His sense of security must always be enlarged and added to, and his opportunities for the exercise of initiative must be enhanced. He must always be made to feel at ease in his work and in his associations with his fellows and superiors. Every effort must be made to keep the pupil from being timid, feeling silently rebellious, or stalling deliberately. Fears must be extricated from his mind, and any sense of inferiority eliminated. Even in the slough of repeated failure he should ever be encouraged and shown that he is making some progress. The maintenance of a satisfactory morale at all times is of prime importance. Such are the more subtle, psychological objectives underlying most of the methodologies recommended generally throughout this paper.

Teacher as a Factor

A seventh point of major stress throughout the literature concerning the low-ability student is the emphasis on the especially important role played in the education of this group by the individual teacher as well as by the administrative officials in charge of the system.[13] In cases of special classes for defectives of various kinds, the specially trained teacher is an almost universally advocated integral part of the program. However, in all teaching of pupils in the low-ability group, with their many psychological and emotional variations, the need for an unusually well-trained, intelligent, sympathetic, patient, and observant teacher becomes basically necessary. This is especially true in small schools where special teachers and psychologists are not readily available. The effective teacher of the slow group must have adequate training in the psychology of learning, child psychology, mental hygiene principles, and guidance, in addition to a substantial background in the subject matter of his own field of specialization and of allied fields. Even where psychological clinics and psychiatrists are made available to the school, the individual teacher must be alert to the various little things which he, in intimate daily contact with the individual student, is more apt to notice than is the expert in his periodic visits and examinations. Without the alert, understanding, and personable teacher, the most carefully planned body of individualized materials and motivating activities may well become as mechanical and prosaically stolid and stifling as formal instruction at its worst. The teacher is ever the most important link between the subject matter and the student, between the student and the administrator, and between the community and the school in general.

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[13] See references 2, 4, 7, 9, 15, 20, 23, 29, 31, 35, 36, 45, 49, 51, 53, 55, 56, 83, 100, 103, 104, 106, 111, 126, 127, 133, 156, 162, 164, 168, 177, 178, 191, 203, 211, 222, 229, 232, 235, 238, 245, 250, 262, 271, 273, 280, 285, 286, 287, 289, 290, 296, 299, 300, 311, 316, 322, 323, 330, 334, 335, 340, 345, 346, 356, 362, 368, 369, 374, 377, 380, 382, 388, 396, 397, 400, 408, 409, 413, 426, 427, 434, 437, 446, 451, 457, 460, 461, 464, 465, 468, 478, 482, 486, 491, 501, 507, 516, 529, 533, 534, 536, 537, 541, 550, 551, 557, 560, 565, 566, 569, 570, 571, 577, 581, 582, 590, 594, 595, 601, 602, 604, 616, 618, 623, 629, 631, 634, 637, 650, 657, 669, 671, 672, 688, 690, 694, 702, 704, 706.

Behavior problems in the classroom are mainly the responsibility of the classroom teacher. Repeated punitive expeditions to some superior's office solve no problem. The problem must ever be met at its source, and the individual teacher is the most logical person to deal with it. Sympathetic understanding and patient explanations may minimize or entirely eliminate what may seem to be colossal barriers. Making the materials presented inescapably attractive to the students will largely do away with absence, tardiness, and disciplinary problems resulting from fear or rebellion, all other things being equal.

The teacher should have available every possible source of information concerning his students. He is the main cog in the wheel which serves to put the testing program into constructive action. If either the evaluation program or personal observation reveals that the student has unfavorable attitudes directly attributable to extracurricular causes, the individual teacher should go into the community to discover and attempt to eliminate these malevolent factors. Even in schools which have visiting teachers, social agents, psychiatrists, and others who help the teacher with this vital work, the individual teacher still frequently has to go into the community and home to track down clues which he has observed in his more intimate, continuous, and cumulative contacts with the students. In this visitation work, teachers may do much to publicize the work of the school, gaining home and community coöperation so necessary for the carrying out of such a program as is outlined in this survey.[14]

The teacher must ever be aware that a "hopeless" case does not exist, and that each child has certain constructive potentialities. The successful teacher is the one who develops these potentialities of the low-ability student to the utmost. A case of failure in the schools is not usually a case of failure by the student; it is generally a case of failure on the part of the teachers or administrators in charge or of some social factor not under the control of the pupils or the school.

Although, as has been suggested, the daily work should seem to rise incidentally from immediate real-life situations, such a procedure actually requires far more careful planning than the mechanically administered formal lesson. It requires that the teacher be alert to the possibilities in every situation and use constructively the relationships that exist between all things. At all times the carefully formulated objectives which the teacher has helped cast in collaboration with his administrative superiors must be kept clearly in mind. There must always be regular conferences between regular teachers, research workers in the school, special teachers, psychologists, and social workers either in or available to the school, and the administrative and supervisory officers of the school to discuss the work they are doing in common and to lay plans for the richest possible fulfillment of their obligations to their charges.

The effective teacher must ever be self-reliant, that is, he must not use textbooks and similar educational materials as crutches to allow a minimum expenditure of effort on his own part. Textbooks, work-

[14] See references 51, 53, 367, 508, 577, 671.

books, self-testing exercises, etc. are, to paraphrase Emerson, the best of things well used; abused they are among the worst. All such devices are omnibus means to general ends. The most important work of the teacher is diagnosing the little but important minor difficulties of the individual student, noting symptoms of the failing student just as a doctor notes the ailments of his patient, and prescribing correct remedies found in the materials offered in textbooks and other sources. The failure to work on such a basis and the substitution of compulsion or domination for highly motivated and individualized materials will most often result in either undesirable docility and submissiveness tantamount to silent rebellion or in open disregard for conduct on the part of many low-ability students.

There will always be certain factors over which the individual teacher may have little if any control, such as poor home conditions, physical defects, large classes, inadequate equipment, etc. In all cases, however, the effective teacher will make the most of the materials in hand in terms of the capacities and needs of his students. The teacher who throws up his hands saying the difficulties are beyond his powers is a person of narrow vision and limited educational background. There is always a great deal that can be done by the effective teacher even under the most adverse conditions. The great difficulty seems to be that this requires much more effort than many teachers are willing to give to their work. Obviously, such clock-slaves have no justifiable place in education.

It is repeatedly noted that a greater percentage of boys than of girls fall into the low-ability groups. Many writers have attributed a significant portion of the cause for this on the preponderance of women teachers, especially on the elementary level. There is a great advocacy throughout the literature of these writers for more male teachers in contact with boys during the highly formative years of their early schooling. This would, they acknowledge, necessitate boosting wage scales and making similar considerations to make the field more attractive to men than it has been in the past. But they say children are usually more shy than adolescents, and a man teacher may well be able to gain more fully the confidence of his boy students and learn the factors contributing to their retardation than a woman instructor can. This, of course, does not mean that the alert female teacher may not be equally successful, or that any man, by virtue of his sex, will be automatically successful. Again the personal element of the teacher himself, bolstered by his educational background, looms as primarily of greatest importance.

As already suggested, the individual teacher must also be the main cog in the mental hygiene program. As Rivlin (529) has summed it up, all too often the well-behaved child, rather than the disturbing child, is the one progressing rapidly toward mental ill health and maladjustment. Individual students rather than problem behavior in the abstract should be studied, and teaching success should be measured in terms of the wholesome attitudes imparted to the child in such a manner that they become an integral part of the student's life and thinking. Sy-

monds (594) [15] gives the following exemplary list of hints to the teacher in relation to the whole matter of mental hygiene:

1. Do not reward child by too much attention when he is not doing the right thing.
2. Do not arouse feeling of elation in children who are not doing the right thing.
3. Give child freedom to do things by himself even if he makes mistakes.
4. Avoid showing emotion in dealing with children.
5. Make what a child does seem reasonable to him.
6. Never suggest to a child that you expect him to do the wrong or improper thing.
7. Where habits are difficult to learn, learning elements should be small.
8. Do not hold standards which are too high.
9. Substitute a desirable activity in place of a bad habit.
10. Do not create a number of bad habits in attempting to set up a good one.
11. Do not overtalk, preach, argue, nag, coax, or complain.
12. Develop talents already apparent.
13. Do not forget the person in discussing part of the person.
14. Do not tie the child to yourself too strongly.
15. Make tasks so simple and easy to understand that they can be attacked without dawdling.
16. Do not use children in classes to supply your own needs.
17. Change the environment fundamentally if necessary.
18. Do not be dishonest because you do not wish to inflict pain.
19. Do not accept exercises done in a careless and slipshod manner.
20. Do not show child too much sympathy.
21. Do not say "too bad" or "what an awful thing to do."
22. Help child analyze his own situations.
23. Be cheerful and enthusiastic when doing routine and boresome bits of work.

Such a list is indicative of at least two things. In the first place it makes imperative the clear definition of what is the "right" or "proper" thing to do; and, secondly, it shows how the whole matter of mental hygiene is a part of the entire educational picture which we are attempting to survey in this paper.

Besides this, the individual teacher must also be a vital cog in the health program. He must be aware of the superficial symptoms of such deficiencies as malnutrition, defects in vision and hearing, lack of sleep, etc. Numerous writers have made up charts providing a quick and thorough check of the various items that the teacher should know about the physical condition of his students. As part of the extensive health program which is more fully discussed in the latter portion of this chapter, the individual teacher, again, is all-important, as he is in every phase of the life of students who *are* the life of the school.

Environmental Factors

In connection with many of the points mentioned in the preceding section, another point of major stress in the literature is the importance of environmental influences, especially with regard to the low-ability

[15] Symonds, P. M. *Mental Hygiene of the School Child.* The Macmillan Co., New York, 1934.

students. Throughout the writings on the subject [16] particular emphasis is placed on the unusually prominent part played in the backgrounds of individual students of the retarded group by such factors as late entrance into school; bad home conditions; poverty; frequent changes in schools; inadequate food, clothing, and shelter; decadent neighborhood contacts, etc. Although the school is not responsible for many of these conditions, it is nonetheless educationally unsound to thrust a child from an undesirable environment into a school situation which is beyond him, adding only to his difficulties and inviting an increment to his maladjustment. The school, therefore, must not only allow as fully as possible for the individual capacities and needs of the students involved, but it must also do what it can to alleviate environmental conditions by coöperation with every available community agency also dedicated to such ends.

The basis for an approach to the alleviation of the environmental factors in the backgrounds of low-ability students will be the information disclosed by the evaluation program. On this broad basis the school must do what is possible in the way of developing a health program and a mental hygiene program by coöperating with physicians and psychologists and with social and welfare workers. In addition to this, regular visiting teachers and the individual classroom teacher seeking coöperation from parents will frequently do much to make home conditions better for the student involved. In all cases, wherever little or nothing can be done to help remove these retarding factors from the child's environmental background, the school must compensate for poor home and neighborhood conditions by provision of a program including such activities as supervised play and study periods, a program grounded in the abilities, interests, tastes, and needs of the students involved. In no case must the teacher become only another restricting influence seeking arbitrarily and blindly to control the student's environment.

Using Community Resources

A goodly number of writers [17] also make a major point of the necessity for the planning and careful execution of a comprehensive program, catering to the immediate and potential needs of low-ability students, by a large variety of school and community activities and organizations. Among these would be continuation schools and other forms of adult education, psychological clinics, child guidance clinics, camps and social service and recreation centers staffed by competent social workers, etc.

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[16] See references 2, 6, 9, 18, 25, 30, 32, 39, 43, 45, 46, 48, 53, 58, 59, 80, 83, 104, 105, 106, 112, 125, 126, 127, 133, 135, 143, 146, 162, 169, 172, 179, 190, 192, 200, 208, 209, 211, 213, 220, 236, 241, 245, 250, 255, 261, 268, 271, 276, 279, 280, 285, 286, 290, 299, 317, 323, 382, 335, 345, 346, 362, 372, 374, 404, 407, 408, 424, 437, 452, 457, 460, 464, 471, 518, 526, 527, 536, 546, 547, 550, 554, 557, 565, 571, 572, 575, 577, 579, 580, 583, 587, 590, 594, 595, 602, 609, 610, 613, 616, 623, 629, 630, 634, 638, 671, 691, 694, 704.

[17] See references 15, 33, 56, 111, 187, 189, 218, 228, 300, 316, 333, 338, 382, 389, 401, 467, 560, 574, 631, 633, 635, 688.

Health and Physical Education Program

The necessity of a comprehensive health program and an abundance of physical training courses, extracurricular events, and similar activities in connection with the school program which seek to minimize or eliminate the handicaps of low-ability students is generally stressed throughout the literature.[18] Especially through extracurricular events, may the low-ability student relegated to a group of fellows on his own level make the social contacts with superior students so necessary for his full development. Such activities are part and parcel of the mental hygiene program which should complement the health and physical education program.[19]

Mental Hygiene Program

Much retardation is due, as has already been noted, to emotional maladjustments. It is these maladjustments which the mental hygiene program seeks to minimize and eliminate as far as possible.

Aside from attempting to provide as well as possible for the fullest development of the individual student, the mental hygiene program should inculcate certain attitudes of mind regarding the particular values of mathematics. Perhaps the most significant among these are the development of an intelligent respect for objective accuracy, uniformity, and definiteness in procedure, and the development of an attitude of critical analysis on the basis of creative thinking and of understanding of the immediate situation in hand.

The mental hygiene program, like all of the other methods described within this survey, should be inaugurated as soon as possible after the beginning of the formal education of the students involved. In the highly formative years of early youth, much more can be done to eliminate the evils which the mental health program attacks than can be done after the causative factors of maladjustment have made their imprints. All of the psychological factors of the low-ability student, such as fears, sense of inferiority, need for praise and success, etc., are concerns of the persons in charge of the mental health program.

Obviously, such a program must be a part of the daily classroom routine, closely related to it, and administered largely by the regular classroom teacher aided by experts in the field. In cases of special disabilities requiring special class administration, the program would be administered by specially trained teachers, but these classes should not be known by any such names as "slow group" or "special group."

Educational and vocational guidance will play an important part in the mental health program as well. Immediate success in daily educational experiences is the precursor to success in some vocation in later life. The guidance program will be based, in part, on information

[18] See references 2, 25, 31, 43, 46, 48, 49, 53, 55, 56, 68, 80, 104, 105, 106, 112, 125, 126, 127, 135, 146, 154, 172, 178, 179, 200, 208, 220, 234, 236, 250, 264, 265, 271, 280, 282, 284, 299, 300, 312, 316, 335, 355, 362, 374, 382, 401, 404, 467, 526, 536, 537, 554, 573, 574, 583, 587, 592, 594, 605, 613, 626, 633, 634, 650, 655, 668, 671, 690, 694, 696, 703.

[19] See references 7, 9, 15, 24, 38, 154, 186, 232, 245, 448, 503, 507, 529, 574, 575, 594, 631, 636, 682.

gained at the psychological clinics, which will provide the laboratories and much of the special direction which the program will need. There will ever be an intimate collaboration between such agencies and the individual teacher or administrator involved.

Community organizations, such as parent-teacher associations and home and school leagues, will also contribute much to the mental health program in their intimate connections with children in their extracurricular activities. In every phase of in-school and out-of-school activities, the concern for the mental health of the child must be a paramount one. The comprehensive mental hygiene program, broadly administered, may well be the tie that binds the whole educational structure together.

Readiness and Placement

The whole problem of mental health again brings up the matters of placement and readiness, issues which are especially important since a great deal of retardation may be traced to the improper placement of materials without regard for the student's readiness to handle them.[20] Many students may not be expected to grasp the meanings of the abstract symbols of mathematics until they are eight or nine years old, but strong visualization of symbols and space relationships of numbers will aid in developing the powers of abstraction. The child should have a mental age of at least seven before his exposure to the more formal aspects of mathematics. The transition from the concrete and incidental to the more abstract and formal should ever be a gradual, continuous, and cumulative learning experience.

In all cases, as Washburne (648) [21] sums up the findings of the grade placement investigations, "there is a point in a child's mental growth before which it is not effective to teach a given process in arithmetic and after which that process can be taught reasonably effectively." What this point is is still highly debatable, for, as Woody (696) notes, readiness implies a combination of biological, psychological, and social readiness. We may also add Sueltz's (592) definition of readiness as the ability to see relationships in experiences with space and quantity. In the light of such definitions, the vital role of the evaluation program in the matter of placement and readiness is the most valid approach we have to these involved and still widely disagreed upon issues. New testing devices must be invented to determine scientifically the location of the "points" to which Washburne refers. Only then can the results of the testing program come fully into constructive educational use. Until such time only such broad generalizations as have been noted and such more specific recommendations as are presented in the ensuing chapter may be said to have some degree of substantial support.

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[20] See references 32, 78, 92, 93, 105, 111, 119, 123, 130, 140, 167, 196, 250, 277, 278, 290, 300, 312, 315, 325, 340, 371, 385, 387, 432, 435, 442, 467, 469, 482, 519, 521, 540, 553, 561, 592, 594, 597, 648, 650, 663, 664, 675, 693, 694, 695, 696.

[21] Washburne, C. W. "Mental Age and the Arithmetic Curriculum: A Summary of the Committee of Seven Grade Placement Investigations to Date." *Journal of Educational Research* 23:229, March, 1931.

Length of Class Period

In conclusion, a number of matters concerning general methodologies for the teaching of low-ability students may well be grouped together.[22] Concerning the length of the class period, most writers advocate short periods peppered with frequent short rest or recreation periods where sustained effort in the activity involved is demanded. Low-ability students, in view of their short attention span and their usually speedy exhaustion, seem to do best under such conditions. These factors, added to the desirability of a highly varied presentation of materials, make a minimum period of ten minutes and a maximum period of thirty minutes most generally desired. Klapper (340) summarizes the general consensus with regard to the length of the formal mathematics period for normal students as follows:[23]

Grades I-II	10-15 minutes
Grades III-IV	15-20 minutes
Grades V-VI	25-30 minutes
Early junior high school	30-40 minutes
Later junior high school	40-45 minutes

Such a scale, of course, would have to be shortened for low-ability students, unless the material is presented incidentally or in units or general projects.

Length of School Day and Week

Concerning the length of the school day and week, the general consensus with regard to low-ability students seems to be that there should be a lengthening rather than a shortening of the unit of time spent in school.[24] This would provide an opportunity for periods devoted to supervised study to replace home study, when home study must be done under unfavorable conditions, and a chance for directed leisure-time activities instead of unsupervised play in frequently decadent neighborhoods. If, however, full advantage were taken of every hour spent by the low-ability student in school, the average present day and week requirements of students for attendance in school might amply suffice. A lengthened school day, where attempted, should ever take into consideration the added possibility of fatigue, and should intersperse recreation freely with regular instruction.

Class Size

Concerning the matter of class size with regard to low-ability groups, the general consensus is decidedly in favor of small classes for such students.[25] A minimized teacher load enables the instructor to devote more time to the individual differences which exist to a greater extent among slow students. The more seriously retarded or handicapped the group may be, the smaller it should be. In the early grades

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[22] See references 126, 127, 300, 340, 491, 612, 668, 702.
[23] Klapper, Paul. *The Teaching of Arithmetic.* D. Appleton-Century Co., New York, 1934, p. 58.
[24] See references 168, 206, 536, 593, 668, 671.
[25] See references 2, 53, 100, 103, 126, 127, 177, 222, 229, 271, 272, 327, 340, 413, 415, 468, 491, 536, 566, 581, 582, 595, 634, 702.

smaller classes are especially more desirable than larger ones. Again, the mere fact that a class is small is no guarantee of its effectiveness. The use that the teacher makes of the added time he has to cater to individual differences is the major determinant of the success of the small class. If mass methods are used in small classes, they are just as likely to prove ineffective as those used in large classes. The recommendations for class size run from maximums placed anywhere from 15 to 25 students, with only a rare advocate of classes larger than the latter figure.

Textbooks

The use of textbooks with low-ability students is particularly limited because these students usually have difficulty in reading for comprehension. Some of the qualifications of good textbooks, in so far as they can be effectively used with slow students, may be summarized and listed as follows: [26]

1. General attractiveness of external appearance, including an interesting title, brilliant colors, pictorial designs, lack of bulk, and frequent changes of text.
2. Authorship by persons of recognized leadership and authority in the field of mathematics.
3. Publication by a reputable concern known for its honesty and reliability in the textbook field.
4. Recent publication date or revision date.
5. Abundance of pictorial materials in the way of drawings, graphs, maps, diagrams, etc., many of them being in color.
6. The presence of such aids as descriptive tables of contents, lists of illustrations, unit divisions, pictorial materials, indices, etc.
7. The expression of a constructive philosophy of education, as noted by the author in the introduction, directions to teachers, or preface, and the carrying out of his philosophy in the body of the text.
8. The use of large, readable print properly spaced on paper which makes for maximum legibility.
9. The use of explanatory data under pictorial materials presented.
10. The arrangement of the materials making up the body of the text into logical comprehensible units affording a gradual transition from one learning experience to the next.
11. The inclusion of practice tests, exercises, and similar devices, together with answer keys so that they may be self-administered.
12. The use of a readily comprehensible vocabulary.
13. The use of problem materials and exemplary explanations based on the daily, real-life experiences of students.
14. The inclusion of references to available supplementary materials.
15. Allowances for varying rates of pupil progress.

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[26] See references 8, 24, 40, 66, 78, 103, 108, 109, 161, 176, 204, 300, 315, 340, 423, 435, 557, 565, 602, 656, 669.

16. The inclusion of analytical discussions of the problems presented for the teacher using the text.
17. The inclusion of workbooks to accompany the text.
18. The provision for specific training in the reading and meaning of the vocabulary and symbols of mathematics.
19. The provision of detailed analytical questions concerning processes and problem materials as a guide to the student.

No matter how excellent a text is, it should never become a crutch wherewith the teacher evades his responsibilities to his charges, and especially to those of low ability. So many teachers have done just this that the literature on the subject is marked by a widespread trend advocating the abolition of textbooks and stating that the problem materials for the elementary classes in mathematics, especially, may well arise incidentally from the everyday situations which arise in the classroom and extracurricular activities of the students. This is, to a large extent, a defeatist attitude. Excellent textbooks in the hands of excellent teachers are generally conceded to be educationally advantageous.

General Equipment and School Plant

Finally, concerning the school plant and its equipment, the emphasis among writers is on the need for the best of modern buildings and equipment.[27] In the teaching of low-ability children the provision of well-equipped workrooms in the industrial arts and the domestic sciences becomes especially important. In addition to the tools and machines needed for such activities, the rooms themselves should be conveniently located, large, well lighted, well ventilated, and, in winter, properly heated. In regular classrooms, the equipment should provide for the fullest possible use of the sensory impressions of the students and should include such equipment as motion pictures, radio, phonograph recordings, public address system; pictorial materials (including wall-pictures of great mathematicians and pictures of architecture showing symmetry), stereoscopic slides, bulletin boards, projection lantern slides, maps, charts, models, blackboard space partly marked off in graph squares, etc.

In addition to these, all kinds of supplementary material should be provided to make the presentation as graphic, varied, and interesting as possible to the low-ability student. Among such materials, selected according to the mental age requirements of the group, would be games, playthings, and equipment of various kinds, such as peg-boards, dominoes, lotto, beads and strings, sandbags, counters like the abacus, graduated measures for solids and liquids, coins, toy money and cash register, price tags, business forms, household scales, clock faces, calendars, postage stamps, flash cards, account books, cardboard and wood for making models, squared and regular ruled and unruled paper, colored crayons and chalk, tape measures, rulers, a telephone directory and toy telephones, triangles and other geometric figures made of cardboard,

[27] See references 42, 108, 109, 126, 127, 146, 151, 164, 219, 242, 250, 286, 381, 468, 512, 536, 602, 634, 668, 688, 702.

and similar materials, scissors, boxes, cartons, signs, etc. For older students, equipment should include protractors, a selected group of good mathematics books,[28] carpenter's square and level T-squares, balances, verniers, micrometers, thermometers, angle mirror, hypsometer, clinometer, slide rule, transit, sextant, level and rod and other surveying devices, etc. A well-equipped mathematics classroom should also be supplied with movable tables and chairs, adequate cupboard and shelf space, tables for displays, museum and show cases, and files for student's and teacher's materials.

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[28] Such books as the following should be available:
Cavendish, *Mathematical Recreations.*
Dudeny, *Mathematical Recreations.*
Lick, *Mathematical Recreations.*
Schubert, *Mathematical Recreations.*
Smith, *Number Stories of Long Ago.*
Smith, *Number Games.*
Smith, *Number Rhymes.*
Weeks, *A Boy's Own Arithmetic.*

CHAPTER VI

METHODS IN MATHEMATICS

It would require a tome to attempt to detail all of the various specific methods which writers of textbooks on arithmetic have prescribed in setting forth their individual programs, and we can do no more here than suggest certain broad methods of presentation which seem generally stressed in the literature on the subject.

Development of the Sense of Number

Throughout the writings concerning the placement of arithmetic and the matter of readiness, stress is placed upon the need for first developing the sense of number and its attendant concepts of time, space, order, relationships, etc. before beginning the formal study of arithmetic. In the first year, at least, and even through the second grade, no formal teaching of mathematics should take place. Instead, the student's sense of number should be developed as fully as possible by capitalizing upon the incidental number situations of daily life as they may occur. Such a method, to avoid chaos, must of necessity be administered by an unusually alert, observant, well-grounded teaching and administrative staff on the basis of the most carefully laid plans. Let us note some of the suggestions that have been made concerning the development of this sense of number in the early formal schooling of the child.[1]

First and foremost, as has been said, it is important for the teacher to discover and exploit to the fullest the rich number experiences with which the child enters the schools. Studies such as those summarized by Brownell (92) give evidence of the well-fitted storehouse with which the child comes to the teacher of mathematics from his preschool experiences. These abilities and achievements must be uncovered in the course of the evaluation program and used as a basis for further teaching. This further teaching will entail a number of important points with regard to general method. In the first place, it will be necessary to supplement the findings of the evaluation program with an investigation of the students' interests and activities in order to provide a solid basis for making the most of the former information. Numerous interest questionnaire forms have been reported and from these have been devised lists of activities, hobbies, and other incidental situations involving number experiences by beginning students.[2] Teachers, together with administrators, can devise such questionnaires and obtain this information without too great difficulty.

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[1] See references 68, 69, 78, 88, 130, 140, 151, 163, 204, 234, 260, 263, 278, 295, 299, 300, 306, 315, 340, 349, 371, 381, 387, 390, 394, 397, 398, 409, 432, 435, 440, 459, 512, 521, 525, 530, 531, 549, 553, 554, 567, 585, 591, 595, 611, 663, 668, 686.

[2] See reference 519.

Secondly, these data (from the interest questionnaires and from the readiness facts resulting from the testing program) should be used to pave the way via incidental learning based on them to a gradual transition to the more formal aspects of the learning of mathematical skills and knowledges. Herein, it seems to us, lies the chief argument in favor of incidental learning in the early elementary years, especially with low-ability students for whom carefully graded, continuous, and cumulative learning experiences must be provided. Since, up until the time these students have entered upon their formal schooling, the method of *incidental learning* of arithmetic has proved itself to be effective, and since a gradual change to more formal learning is a *sine qua non* of their learning processes, it would not seem wise to thrust them into the throes of rigid formalism upon their entrance into school.

Incidental learning in school may well be induced through games and similar play activities which make the most of the child's love for play and doing things. Innumerable interesting and informative counting games exist which help the child to learn the order and relationship of various number sequences and combinations and to recognize the arbitrary symbols for the highly abstract number concepts for which they stand. Clark, Otis, and Hatton (140) have listed the steps in the learning of number as follows:

1. Appreciating that one group of objects contains *more* objects or *fewer* objects than another.
2. Appreciating that four stars and four circles, for example, are alike in one way, at least.
3. Learning the names of the numbers up to five, their order and their meaning.
4. Learning to say the number names from one to one hundred in order as a series, and to recognize that six is more than five, etc.
5. Counting, that is, determining the number of objects in a group by pointing to them one at a time and realizing that the last number said is the total number of objects in that group.

Such a procedure in the learning process may well be kept in mind in using various concrete devices in the presentation of material. Among the concrete teaching devices and play activities advocated for the development and extension of the sense of number, we may note a typical list as follows:

1. Using cards with numbers on them, or cards with pictures of numerical groups on them; e.g., one cat, two dogs, three girls, four boys, etc., and using the flash card technique. Those pictures having bright and varied colors are preferable. Sand of different weights in containers of various colors, bearing number symbols on them, is used as another means of teaching the recognition of number.
2. Using magazine and newspaper advertisements showing number facts, again with colored materials preferable.

3. Using various objects cut from cardboard and having student put fixed number in some container or make up various groupings from a general depository, e.g., two pears and four apples, two dogs and one cat, etc.
4. Stringing beads with regard for number, and working with the abacus.
5. Using checkerboards, peg-boards, and lentils with a particular regard to the number experiences involved.
6. Working with coins, using real coins where possible.
7. Teaching the telling of time and the days of the week, emphasizing that Tuesday is the third day, followed by Wednesday, the fourth day, and preceded by Monday, the second day. Also reading the thermometer.
8. Using objects by means of games and the like, always within child's experience, to teach size, form, and location concepts of big, little; long, short; more, less; many, few; too many, too few; square, circle, oblong; right, left; front, back; over, under; top, bottom; above, below; at the beginning of, at the end of, beside; half, quarter, third, equal; etc. Investigators have shown that teaching the concepts of "equal" and "same" are among the most difficult to teach. Comparison of the children within a class itself for size will help to teach these concepts. Comparatives and superlatives such as big in relation to bigger and biggest must also be taught.
9. Playing games in which the keeping of scores is necessary, such as tossing bean bags into a basket, tossing rings onto a peg, etc.
10. Playing other games and puzzles involving practices with numbers such as dominoes, lotto, etc. as well as activity games such as Pussy Wants a Corner, Drop the Handkerchief, Red Rover, missing number games, guessing games, etc.
11. Playing store, conductor, post office, etc.
12. Using a number ladder to visualize the various number relationships.
13. Using differentiated colors to teach odd and even numbers and number groups such as tens, twenties, etc. In teaching number concepts, however, it is important that the objects used be varied so that the child does not associate numbers with a particular class of objects.
14. Using devices such as Larbert's wooden peg stand, Tillick's bricks, etc.
15. Using various measuring devices such as quarts, pints, rulers, yardsticks, etc. in actual measurement activities, such as measuring the area of the student's desk, bringing a pint of water to take care of the flowers in the room, etc.; also, weighing various quantities using a household scale in the room.
16. Using book pages, e.g., asking what picture is on some specified page and seeing which student can find it first.
17. Using a large chart with numbers on it in columns. The teacher may ask pupils to identify numbers by pointing to them, or ask the pupils to name four less than twenty or six more than fifteen, etc.

18. Training in cutting out numerals and thus impressing their shape by bringing in the associations of the large muscular movements used in cutting.
19. Practicing writing and naming numerals at the same time.
20. Learning tunes on the piano with numerals painted on the piano keys.
21. Doing an abundance of blackboard work and seat work, using drawing techniques to illustrate number relationships.
22. Dramatizing little plays concerning number and acting out number relationships by using groups to represent the various numbers involved.
23. Making excursions outside the school, for example, to a department store, noting the presence of number wherever it is encountered.
24. Marching and doing exercises in time to music, counting off the movements involved.
25. Reading telephone numbers from a directory, and dialing numbers on a toy telephone.
26. Learning the difference between cardinal and ordinal numbers by learning that a child cannot be third in line unless there are at least three children, and that there cannot be a fifth day of the month unless there are at least five days.
27. Making posters on mathematical subjects.
28. Making mathematical exhibits.
29. Recognizing and using mathematics in all of surroundings; e.g., tiling, linoleum, carpets, windows, doors, tables, chairs, boxes, etc.
30. Telling stories related to the history of mathematics.
31. Designing and making costumes for dolls or for dramatizations involving measurement, cutting, fitting, etc.
32. Taking part in other domestic science and manual arts activities such as making curtains, shelves, boxes, etc. for the classroom.
33. Taking part in special activities involving number such as planning a flag for patriotic holidays.
34. Wrapping packages, requiring judgment concerning the size of the paper to be used in connection with the materials to be wrapped.
35. Having the experience of buying such things as lunches, carfare, school supplies, etc.

Such a list is indicative of the wide variety of interesting and meaningful activities based on natural, everyday child experiences with which it is possible to make the development and extension of the sense of number within low-ability students as concrete and effective as possible. Dwelling on the concrete is not slowing down with such students, nor with normal students in many cases, but is, rather, a most natural step in the development of the number sense. Such a procedure fills the need to awaken this sense of number and articulate it in readily observable form from its structural connections with the total experience involved.

Some of the observable behavior patterns which this development must evidence in its early stages are as follows:

1. The ability to count, first up to ten objects and thence up to from fifty to one hundred, which may be tested by having the child silently count a number of objects and tell how many he has counted or by having him separate a given number of objects from a group containing a larger number.
2. The knowledge of the cardinal and ordinal terms and their sequences, first up to ten, and they beyond it, including knowledge of the location of each number within the group; e.g., that five comes after four and before six.
3. The ability to compare and to take groups apart and put them together again, as well as to count them.
4. The ability to give proper attention to groups as a whole as well as to component parts of those groups.
5. The ability to recognize the symbols assigned to numbers and number groups.
6. The ability, in groups beyond ten, to tell how many tens and the number of units each group contains.

Importance of Mastery of the Fundamentals

When reasonable development of the sense of number has been achieved, the next step is the all-important matter of mastery of the fundamentals; i.e., addition, multiplication, subtraction, and division.[3] Then, and then only, it is educationally sound to proceed to the teaching of these basic skills and knowledges. With low-ability students, as well as with students in general, carefully detailed, varied, constructive repetition, drill, and review should be continued as long as necessary to achieve mastery of the fundamentals, since it has been repeatedly shown that these processes in arithmetic cover over 75 per cent of all the practical life situations in which mathematics functions.[4]

True waste occurs when the child is plunged from one half-assimilated body of knowledge into another more complicated one which depends upon the first for complete understanding. This is especially true of the low-ability student, with whom complete mastery and accuracy are prerequisite in the gradual transitions from one mathematical area to the next, since number learning, particularly, grows increasingly incomprehensible. Investigators and teachers have repeatedly pointed out that the cause of most mathematical error and failure is the fact that students have not mastered the fundamentals, and this lack of mastery of the basic processes may often be attributed to the fact that the formal teaching of them was begun before the number sense had been sufficiently developed. The testing program must play its usually vital role in determining whether the number sense has been developed

[3] See references 27, 30, 70, 78, 86, 100, 110, 131, 137, 140, 152, 176, 190, 210, 262, 278, 288, 309, 315, 321, 337, 398, 454, 459, 470, 471, 483, 525, 535, 545, 567, 568, 570, 619, 634, 647, 650, 652, 662, 663, 668, 669, 672, 678, 680, 683, 687, 692.

[4] Wilson (678), for example, has shown it to be 76 per cent. Wise (687) has calculated it at 85 per cent.

within the individual student and whether he is ready for the learning of the fundamentals.

Careful analyses must be made of the number facts which the student actually needs or will need, and attention must be concentrated on these to the utmost, with complete accuracy as a goal. This will eliminate much that is now being taught to the low-ability student, and will not only serve to motivate the number work for him but will also minimize sharply the amount of material for which he is held responsible. It will then be conceivable to expect success from him over a relatively limited area. Lists of common sources of error must be exploited to the utmost both in the evaluation program and in all the teaching procedures which follow.[5] However, such a list must not be used as a crutch; its great value is in affording the instructor at least one means of discovering and dealing as directly as possible with the mechanics of the mathematical work involved.

One cannot overstress the fact that it is almost useless to teach the fundamentals as isolated facts, especially with low-ability students. The only profitable way to teach skills and knowledges, especially in initial stages, is within meaningful, functional, instructional units. Informational rather than computational mathematics should be the main concern of the teacher of the tool aspects of the mathematical sciences. Tables such as those listed by Smith (567), for example, are invaluable when used as aids, just as are the lists of known common errors noted above. However, all of such means must be used only as means to an end and never as the end itself. Every teaching device must be regarded in the light of its efficaciousness with the capacities and needs of the individual student concerned.

Addition

Studies such as that by Reid (519) have shown that, in the first years of elementary education, addition situations occur much more frequently than subtraction in the incidental number situations which arise. Therefore it seems logical that addition should be the first of the fundamental processes to be taught, after the number sense has been developed. Aside from the ability to count and read numbers at least up to twenty, the low-ability student should have assimilated certain elementary concepts of size, form, and location before attempting addition.

Some writers have suggested that the best time to begin the teaching of a new process is Tuesday morning after the child is rested from the rigors and distractions of the week end; it should always be presented as the natural outgrowth and continuation of what has gone before. It is extremely unlikely that even normal first and second graders will be mentally mature enough to master addition and subtraction facts in isolation.

It is well not even to tell pupils that they are learning addition or any other process until they are well on their way to an understand-

[5] See references 110 (pp. 203-7), 137, 309, 340 (pp. 68 ff.), 471, 535, 545.

ing of it. It is essential that transitions from one mathematical process to another be made so slowly and gradually and be bolstered by such a wealth of varied and interesting, simple, concrete presentations that the new materials will become an integral and inextricable part of the materials which preceded them. For example, such devices as the abacus, spools on strings, or finger counting may be used to demonstrate the mechanics of the first steps in addition and other fundamental processes. Writers such as Inskeep (300) empirically note that some low-ability children can learn addition in no other way than by counting on their fingers. Such a device as a means to an end may well be countenanced, but as an end in itself is not generally desirable. It is vital that the child advance to the place where he can clearly see, understand, and appreciate the difference between counting and addition, and any device which deters this progress may well be considered more damaging than helpful.

Again, the materials must be highly motivated for the low-ability student, so that he may see the importance of mastering what he is learning in relation to his own needs. This will mean teaching him only the addition which it will *pay* him to learn in terms of generally demonstrated needs rather than putting him through the hoop-jumping of ceaseless and meaningless mechanical drill and review. In fact, the time saved by omitting the non-essentials may well be spent in achieving as complete mastery as possible by means of highly varied individualized and motivated drill procedures after the process of teaching, testing, and reteaching has gone forward. The low-ability student, as well as the normal student for that matter, *must* achieve as complete mastery as possible of any single step or process before proceeding to the next step or process. Analyses, such as those cited by Ingram (299),[6] show that mastery of addition is not the simple matter so many have made it out to be by setting up the 45 combinations, the learning of which constitutes the ability to add. These writers have shown that there are at least 100 addition facts to be learned when zero and reverse facts are counted. In fact, in all the fundamentals, there is a greater multitude of number facts to be learned than is usually recognized—Osburn (471)[7] lists 175 combinations. Studies such as that of Phelps (497) have shown that slow groups have achieved a greater degree of accuracy in addition than more rapidly advancing groups.

It is impossible to overtrain low-ability students in the fundamental processes, but, since the time at the disposal of the school for the teaching of these processes is necessarily limited, it is well to note some of the more generally advocated methods for teaching as effectively as possible, making the maximum use of the time at hand. Some of these proposed methods are as follows:[8]

1. Studies and listings of generally known major sources of error in addition may be used, including those described by Brown (86),

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[6] p. 360.
[7] pp. 19, 167-9.
[8] See references 34, 65, 74, 86, 110, 113, 114, 116, 139, 140, 162, 249, 298, 299, 300, 312, 315, 340, 440, 470, 471, 497, 519, 540, 627, 646, 668.

Brueckner and Melby (110),[9] Johnson (312), and Klapper (340),[10] noting such factors as the following:

a. The difficulty of carrying from one column to another, such as forgetting to carry, adding irregularly to carried numbers, carrying the wrong number, etc.

b. Other flaws in column addition, such as adding large numbers first, having trouble with the second addition in the column, forgetting the sum and repeating the work, adding by tens, losing the place in the column, inspecting the example to find the starting point, failing to hold the number in mind while another is added to it.

c. Lack of knowledge of the combinations themselves.

d. Reliance on counting in place of addition.

e. Bridging the tens.

f. Trouble with zero.

g. Breaking up combinations.

h. Roundabout methods.

2. Intelligent use may be made of a set of rules like that of Thorndike for mastery of column addition, including the following points:

a. Keeping one's place in the column as one adds.

b. Keeping in mind the result of each addition until the next number is added.

c. Learning to add a sum to the thought of a number.

d. Learning to neglect an empty space in a column.

e. Learning to neglect zeros in a column.

f. Learning to add when the addition involves the higher decades.

g. Learning to write the figure signifying units rather than the total.

3. Students may be taught to break down long columns into shorter ones, probably not exceeding six listed numerals or sets of numerals, and to add each separately, then adding together the totals. Such a procedure would apply equally in real-life situations where the student would be confronted with long columns to add. This method is based on evidence that there is little practical need for the use of long columns, and that most children can add steadily with a maximum accuracy for six consecutive additions.

4. Both upward and downward addition may be taught, one as a method, and the other as a check.

5. Students may be taught to add the digits in a column one by one in the order in which they occur.

6. The combinations may be taught progressively with regard to the order of their difficulty, with automatic recall as the objectives based on the laws of habit formation; i.e., the law of exercise indicating that mental connections are strengthened by use, and the

[9] p. 203.
[10] pp. 269-71.

law of effect indicating that mental bonds are strengthened by use followed by pleasure and satisfaction.

7. Combinations may be arranged in such a way as to avoid answers that encourage counting as a permanent method instead of learning the combinations or that encourage adding or subtracting from the preceding combination as 5 + 4 followed by either 5 + 3 or 4 + 6.
8. The addition and subtraction facts may be taught together. With low-ability students, however, with their high degree of susceptibility to confusion in failing to see readily associative relationships, this is generally inadvisable. There is abundant evidence that learning of the building up processes (addition and multiplication) is easier than the learning of the breaking down processes (subtraction and division) and that multiplication can be shown to be a short cut to addition, as division can be demonstrated as a short cut to subtraction. For these reasons, it seems preferable to teach addition by itself first, followed by the teaching of multiplication.
9. Time may be devoted to the recognition of addition situations as they occur in real life.
10. Checking should be taught as worth-while, especially with low-ability students with whom the stress on accuracy and complete mastery must ever be a primary one.
11. Highly distributed practice may be given in short periods, using visual and written work rather than auditory and oral work.
12. Students may be provided with keys listing correct answers for the use of self-administrative practice materials. Such materials, however, must be used with extreme caution with low-ability students in particular, since their frequently demonstrated lack of initiative may lead them to an abuse of these aids.

Many of the methods listed for enlivening and varying the development of the number sense are also efficacious in the teaching of addition. Among these methods which may well be useful in the presentation of the addition process are the following:

1. The use of drawings by the students, such as two boats and three automobiles making a total of five objects.
2. The use of various racing games in competitions for the learning of the combinations.
3. The use of numbers cut from old calendars which children may use in building examples and finding answers.
4. The building of addition examples with various objects, such as dry peas, beans, toothpicks, seeds, pencils, rulers, pieces of chalk, etc.
5. The playing of games, such as that in which children impersonate railroad cars and hitch two of them onto a train of five others, etc.
6. The playing of other games, such as Blind Man's Buff, Pussy Wants a Corner, Fox and Geese, Stepping Stones, guessing games, and especially games involving the keeping of scores.
7. The use of various arithmetic puzzles based on addition.

Multiplication

The teaching of multiplication follows the teaching of addition in the discussion here for the following two reasons, which are particularly relevant to methods with low-ability students.

1. Low-ability students learn more readily the building up processes, i.e., addition and multiplication,[11] than the tearing down processes, i.e., subtraction and division.
2. Teaching multiplication after addition helps to make for a more gradual transition to the learning of the former body of knowledges and skills since it can be demonstrated as a short cut for addition and can thus motivate the low-ability mind which ever needs the highest motivation and the most gradual transitions possible.

We may add to these the evidence that addition and multiplication comprise over 50 per cent of the mathematical experiences in adult life. According to Wilson, as summarized by Brown (86), the percentages are as follows:

Addition	20.1
Multiplication	31.8
Subtraction	12.9
Division	11.1
Fractions	9.0
Simple accounts	5.5

The placing of such a widely-used process as multiplication earlier in the curriculum of low-ability students will provide them with more experience with that process as they go along to other steps in mathematics. This will make for a fuller operation of the law of exercise in the formation of the habits so vital to their learning processes.

This placement of multiplication after addition is by no means generally accepted. A very respectable number of authorities place the teaching of subtraction either after or contemporaneous with the teaching of addition. A great deal more research may well be instituted to determine more exactly which of these two processes should have precedence in the curriculum. In teaching low-ability students, presenting them with a double barrage of both addition and subtraction simultaneously seems generally inadvisable, as it serves only to confuse and discourage them. The chief arguments in favor of teaching subtraction after addition or together with it are as follows:

1. Evidence indicates that students on the early elementary levels use addition and subtraction almost to the exclusion of multiplication and division.
2. Children have given evidence that they learn subtraction facts more easily by relating them to the corresponding addition facts and by understanding the correlative idea. The use of addition and subtraction as counter checks upon one another is widespread.

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[11] Inskeep (300) has noted that multiplication is the easiest of the fundamentals for low-ability students to master.

This whole matter is only part and parcel of the whole confusion, already noted, which hovers over the matter of placement. We can only suggest that, with regard to low-mentality students, multiplication placed after addition may well prove more efficacious than subtraction placed after addition in the curriculum.

Most of the general ideas involving the teaching of addition and the methods used apply equally well in the teaching of multiplication and to each of the other processes discussed in this chapter. We may note, however, some generally advocated methods particularly relevant to the teaching of multiplication to low-ability students as follows:[12]

1. Lists of widely-demonstrated areas of error in multiplication, such as that by Klapper (340),[13] should be used and the teacher should point out such matters as the large number of difficulties regarding zero, the persistence of such associations as $4 + 4$ or $6 + 6$ when asked for 4×4 or 6×6, the trouble in placing the second partial multiplier in the right place when multiplying by two figures, etc.
2. The various devices suggested for the development of a sense of number may be adapted to the presentation of multiplication, with such games as automobile and aeroplane games furnishing interesting incentives for learning the multiplication tables. Multiplication is an especially effective subject to use in competitive speed contests, although speed should never be a primary objective with the low-ability student.
3. The students should memorize the tens tables first, followed by the fives, twos, threes, fours, sixes, sevens, eights, and nines. Some writers have advocated teaching nines before sevens as they are easier to learn.
4. Each of the tables taught should begin with zero, e.g., 0×2 is zero, 0×4 is zero, etc.
5. It is not necessary to teach the tables beyond tens, i.e., the elevens and twelves. Such a report as that of Wahlstrom indicates that actual usage of the tables is limited mainly to those up to and including fives. Much disagreement exists on the matter of eliminating the tables beyond tens, but, with low-ability students, the general view is that the teaching of elevens and twelves is not imperative.
6. There is much disagreement also on whether the combinations should be taught in table form or as single facts. With low-ability students the latter method seems preferable.
7. It is recommended that low-ability students be taught the tables rather than the classic 54 multiplication facts, because such students usually have inefficient memories.
8. Generally students need not be taught multiplication beyond a two-place multiplier.
9. In introducing multiplication, the first few tables may well be introduced as addition and then presented as multiplication, so that a gradual transition may be made from the one process to the other.

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[12] See references 65, 78, 86, 114, 140, 248, 299, 300, 342, 344, 440, 627, 646, 668, 676, 692.

[13] pp. 306-7.

10. Multiplication should be taught upwards, especially with slow students. Later it may be taught downward as a check, provided that teaching this added method is not confusing to the students.
11. In problems involving multiplication, the multiplication facts should occur early in the problem during the period when the process is being taught.

Subtraction

The general methods and enlivening devices already discussed in relation to the teaching of addition and multiplication are applicable to the teaching of subtraction as well. We may note as indicative of more widely advocated specific methods for the teaching of the latter process to low-ability students the following suggestions:[14]

1. Lists of widely-demonstrated areas of error in subtraction such as that by Klapper (340)[15] should be used and such matters as the large percentage of errors due to "bridging" and the inability accurately to manipulate zero should be pointed out.
2. For low-ability students, it seems generally advisable and most effective to use the "take-away, borrowing upward" method. The terms "take-away" or "how many have I left?" should be used in order to approximate the way in which subtraction situations occur in real life. However, a great deal has been written and much confusion still exists concerning the most effective method of teaching subtraction generally. Many writers have commented on the superiority of one or another specific method under their various names, e.g., "equal-additions" method, "Austrian" method, "decomposition" method, "take-away" method, etc., but there does not seem to be sufficient conclusive evidence of the superiority of any one specific method of teaching subtraction generally.
3. Increasing in the subtrahend seems to have the advantage of a little greater ease in operation than decreasing in the minuend.
4. As has been noted, some writers advocate the teaching of addition and subtraction together. This is generally inadvisable with low-ability students since it only serves to confuse them in their usually deficient abilities to see relationships readily. However, it is distinctly advantageous in the teaching of subtraction to relate the subtraction facts being taught to the corresponding addition facts.
5. It is not necessary to burden the low-ability student with the terms subtrahend and minuend, but he should be taught to recognize a subtraction situation as it may occur in a problem, to know what to subtract from what, and to realize that the symbol "—" indicates subtraction.
6. Numbers having larger minuends than subtrahends in all of the digits concerned should be presented first.
7. Devices, such as taking a certain number of objects from a pile with a larger number, may be used as an introduction to develop the concept of subtraction.

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[14] See references 41, 65, 86, 110, 114, 115, 140, 249, 298, 299, 300, 301, 310, 313, 315, 340, 440, 470, 540, 604, 627, 646, 668, 681, 692.

[15] pp. 287-91.

Division

Among the more specific methods generally advocated with regard to the teaching of division, the following are indicative of general trends:[16]

1. Lists of widely-demonstrated areas of error such as that by Klapper (340)[17] should be used and such matters as errors in computation and trouble with zero should be pointed out.
2. It is expedient to have the low-ability student learn the division tables and to point out to him that they are the reverse of the multiplication tables. The problem "8 ÷ 8 equals," for example, should be read, "eight, how many eights? One," etc., with stress on the term "how many?" Teaching division in its relationship to multiplication is most desirable. It can always helpfully be pointed out that, if $3 \times 7 = 21$, then there are three sevens or seven threes in 21.
3. It is not necessary to burden the student with the terms dividend, divisor, quotient, but mainly to impress on him that the symbol "÷" indicates division, a dividing of something into its component parts.
4. Introductory devices, such as dividing various objects, may be very helpful in transmitting the concept of division.
5. Short division should always precede long division and the students should be told that it is a short method for doing long division, which is usable because they are dealing with short numbers.
6. Students should be shown how to do short division problems by long division, thus minimizing their imaginary fears of the latter process.
7. The simple formula "how many times, then take away, then bring down" should be visualized for the students by being written on the board and diagrammed or illustrated by placing the steps on a drawn stairway or a railroad track drawing. The formula should then be committed to memory.
8. Two-figure divisors should not be introduced until students can do short division by the automatic functioning of the above formula.
9. It is generally inadvisable to burden low-ability students with divisors over 100 and a five-place dividend, since evidence indicates that real-life situations rarely make use of larger figures.
10. Repeated stress on the operation of the process of division cannot be overemphasized, since evidence has repeatedly shown division to be the main source of general error among the fundamentals. Furthermore, the teaching of long division, particularly when presented in relationship to multiplication, offers a splendid chance for review of subtraction and addition. With low-ability students, repeated but ever varied and interesting work with division should serve as the climax and the clearing house for the teaching of the all-important fundamentals.

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[16] See references 86, 137, 246, 247, 248, 299, 300, 312, 315, 340, 653, 692.
[17] pp. 320-2.

11. More emphasis should be given to the synthesis of the component factors in long division and less emphasis to the analysis of the skills involved when isolated from the unified process.

Fractions

The teaching of fractions logically follows the teaching of division, in relationship to which it should be presented. It should be demonstrated that every time one divides anything, he has parts or fractions of the whole left. Some authorities, such as Osburn (473) and Johnson (312), state that the teaching of decimal fractions is simpler to understand, especially for low-ability students, than common fractions, and should be taught before common fractions. As a matter of fact, fractions, decimals, and percentages are really only different phases of one large process. They should all be taught with a marked emphasis on the relationships which exist between them. Generally, however, low-ability students may visualize ⅓ or ½ more readily than .33 or .50 by such means as are described below. And because, without breaking the ground first by means of common fractions, the student may well confuse decimal fractions with whole numbers, it is believed more advisable to place the common fractions first in order in the curriculum. Valuable research could well be instituted to determine more accurately the validity of the placing of these two types of fractions.

The following suggestions are among the more specific methods generally advocated with regard to the teaching of fractions:[18]

1. Lists of widely-demonstrated areas of general error such as those of Brueckner (166) and Klapper (340)[19] should be used, and such failings as errors in cancelling, changing mixed numbers to improper fractions, reducing proper fractions, changing improper fractions to mixed numbers, etc., should be pointed out.
2. There is evidence to substantiate the fact that multiplication of fractions should be the first of the processes taught, since it seems to be the easiest for low-ability students and minimizes the imaginary fears which fractions may hold for them. This should be followed by teaching them division, addition, and finally subtraction of fractions.
3. Numerous surveys have shown that well over 90 per cent of the real-life situations involving fractions concern themselves largely with the following: ½, ⅓, ¼, ⅔, ⅕, ⅛, and ¾. The teaching of fractions to low-ability students should limit itself largely to these, with repeatedly varied and interesting presentation aiming at full mastery.
4. Surveys have further shown that well over 95 per cent of the fractions involved in real-life situations involve small denominators not exceeding 8, although denominators up to 12 in connection with the use of "dozen" and parts of dozens warrant extension up to that limit in teaching low-ability students.

[18] See references 40, 78, 86, 98, 107, 262, 299, 300, 312, 315, 322, 340, 451, 473, 519, 646, 668, 678, 684, 687, 692.
[19] pp. 357-60, 365, 374.

5. Students should be introduced to fractions by such devices as the drawing of simple diagrams and geometric figures and the cutting out of such figures, the cutting of strips of paper representing fractional amounts, and the use by the children themselves of such actual measurements as measuring a quart of water into two pints.
6. All multiplication of fractions should be demonstrated as ½ × 5 becoming ½ × 5/1, or 6½ × ⅓ becoming 13/2 × ⅓, etc.
7. Multiplication, especially, and then addition of fractions should be mainly stressed, since subtraction of fractions seldom occurs in real-life situations, while division of a fraction by a fraction almost never occurs.

One cannot overemphasize the work with fractions with low-ability students since this area, together with division, seems to be the most difficult in elementary education.

Decimals and Percentage

Decimals, which some writers consider easier to master than common fractions, should provide no great difficulty for low-ability students if they have mastered the fundamentals.[20] If the pupils are shown the operation of the fundamental processes involved with decimals and are taught the concept of parts of wholes on the basis of their experiences in division and with common fractions, the teaching of decimals will involve mainly an understanding of the operation of the decimal point. This should be made habitual by means of repeated and varied drills, with accuracy in the fundamentals still being emphasized. Lists of common errors in decimals, such as those by Brueckner (99) and Klapper (340),[21] give evidence of the fact that this area is no green pasture, especially if the preceding fundamentals have not been mastered.

It has been demonstrated that decimals and percentage may well be studied together. Both decimals and percentage should be presented as visually as possible, by means of various activities such as store projects, buying and selling transactions, banking projects, the cutting out of price citations from magazines and newspapers and formulating of problems from them, etc. In real-life situations the use of decimals occurs almost entirely in situations involving the use of money. Wherever possible, real money should be used in preference to toy money to add to the creation of the verisimilitude of the activity being engaged in.

It is well to note again that, since decimal fractions are considered to be easier to comprehend than common fractions, especially if the students have mastered the preceding fundamentals, decimals should be taught before the common fractions in the curriculum. We have been able to discover no significant scientific evidence that conclusively establishes this precedence. Therefore, for reasons already noted, we are placing the teaching of decimals after, rather than before, the teaching of common fractions. We believe that research to clear up this point more accurately would be more than worth-while.

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[20] See references 99, 299, 300, 312, 315, 340, 473, 658, 668, 692.
[21] pp. 382, 392-4.

Written and Mental Arithmetic

Probably one of the greatest areas of difficulty on the elementary level for the low-ability child, as well as for the normal child, is in the matter of solving both oral and written verbal problems.[22] By the time verbal problems (or problems which are stated in concrete form) are presented to the student, he should have successfully made the transition from mental to written arithmetic, the one being the natural complement of the other. Written work in arithmetic should be introduced as early as possible in the teaching of the low-ability student, because it helps him to visualize his work as well as to manipulate numbers in accordance with his own rate of speed, giving him a means to handle numbers which may elude the limitations of his memory. A gradual and natural transition may be effected from the early school activities in drawing figures and pictures to visualize the preschool and primary-grade number experiences of the student to the learning of the number symbols which man has arbitrarily attached to those experiences. The writing of these symbols should be taught along with the development of the number concept, and should be preceded and accompanied by mental arithmetic situations of such simplicity that success is guaranteed and an adequate foundation is obtained.

The vast store of number experiences in the everyday existence of young children should ever be the source of materials for the parallel and retroactive development of both the mental and written phases of arithmetic as soon as possible after the entrance of the child into the school. Each has its especial value to the student: mental arithmetic to facilitate drill work and to help in learning to judge the correctness of the mathematics involved in the buying and selling transactions he may meet in his later life; written arithmetic to provide a tool for handling number beyond the ready manipulation of the mind, to act as an added aid to drill (especially that which is self-administered), to allow the student an ease and assurance in his contacts with number in competition with his fellows and in the needs of later life, and finally to give him the skill necessary for effective problem solving.

Arithmetic-Vocabulary Relationships

With regard to problem solving, without doubt one of the chief causes of difficulty in this area is the added factor of vocabulary.[23] A wealth of evidence exists to establish undisputably the fact that success in problem solving is directly related to knowledge of and ability with vocabulary. The slow student may be particularly handicapped in vocabulary since he is usually less able to master word meanings, read effectively, and develop his vocabulary. Such students may well, on the basis of repeated drill, become the mechanical manipulators of number. The ability of a student to read and write numbers must never be confused with his ability to understand their values or significance. The teacher must always check the exact nature of the concepts of the

[22] See references 78, 298, 300, 432, 592, 602, 652, 692.

[23] See references 2, 4, 32, 36, 82, 110, 120, 126, 127, 130, 137, 140, 172, 194, 204, 210, 288, 299, 300, 309, 312, 333, 340, 348, 365, 371, 397, 440, 453, 454, 471, 472, 473, 505, 506, 519, 520, 535, 536, 554, 557, 583, 592, 595, 597, 600, 604, 614, 622, 651, 660, 662, 668, 669, 677, 696.

terms assimilated into his quantitative vocabulary. The habit of connecting words and symbols with meanings is essential, for without it these symbols may well offer the student a false sense of security in the employment of certain words and principles without any attempt to understand what is really implied by their usage.

This intimate relationship between the ability to read and the ability to handle arithmetic situations effectively is an argument in favor of delaying formal presentation of the fundamentals until the third grade, by which time the quality and quantity of the student's reading skills will have materially improved. This close relationship should further provide a common ground upon which to establish a close and meaningful correlation between the English and the arithmetic work of the elementary school. The whole matter of readiness for arithmetic is tied up with the knowledge of the language elements of the situations involved, including complete comprehension of the arbitrary symbols indicating the nature of the mathematical processes and relationships.

Among the generally advocated methods for the improvement of vocabulary in relation to mathematical ability we may note the following as indicative:

1. Lists of common errors in vocabulary and reading, such as that by John (309), should be used, including such points as failure to reread a problem, misunderstanding a situation due to vocabulary used in the problem or lack of vocabulary ability by the student, significant omissions or errors in reading, confusion caused by parentheses, etc.
2. Lists of the necessary fundamental vocabulary needed in arithmetic such as that of Pressey and Elam (505) should be used.
3. Texts and lesson presentations should provide for specific training in the reading and the meanings of the vocabulary and symbols of mathematics. It is important to remember the difficulty in acquiring a number vocabulary, which must accompany the mastery of a reading vocabulary of words alone. The concept "dog" is less difficult to visualize than the concept "five." The differences and similarities between such concepts as "black dog" and "white dog" are easier to master than the concepts "five dogs" and "five cats." The generalization "three added to two" is universally applicable, while no such generalization in words alone is required of beginning students in reading.
4. Added to these difficulties there is the need to demonstrate the special techniques necessary for the reading of numerals as distinct from the reading of words. The students must be taught to locate the beginning and the end of the numerals involved. They must be able to discover and identify the respective units making up each numeral. They must become familiar with the numerals and the parts of numerals to be read in their various combinations. They must develop economical habits of brief eye pause. This list is extended at length in the study by Terry (600).
5. The language used within problems as well as in all written directions must ever be the language used by children and not by adults.

It should be simple and straightforward in thought. Such simplicity, however, does not necessarily denote that the sentences must be choppily short or that all the words must be of three letters.

6. Terms requiring definition or new terms should be defined or stated only after the lesson has been properly developed and the materials mastered, so that the child is given a full grasp of the functions and the characteristics of the term in question. Such definitions should be arrived at by the members of the class working together, rather than arbitrarily dictated to them for memorization. Their complete understanding, not memorization, should be the prime objective of such an activity.
7. Long, complicated names and terms should be avoided, e.g., denominator, quotient, subtrahend, minuend, etc. It is sufficient for low-ability students to be able to recognize the process involved and the meaning of the symbol designating the process involved. It is important to remember that low-ability students usually have a dread of incomprehensible terminology, and their imaginary fears are one of the chief obstacles for them to overcome.
8. Terminology such as "how many?" with division, and "take away from" in subtraction should be capitalized upon.

Problem Solving

In the early number experiences of these students within the school the abundance of verbal problems with which children come into daily, intimate contact should be first presented to them orally, and gradually the written symbols connected with them can be introduced and developed parallel with a continual stress on the oral presentation. Problem solving in its simplest forms should be introduced as early as possible, since number situations in real-life experiences seldom if ever occur in isolation. Many of the devices already mentioned in connection with the development of a number sense and of ability in the fundamental processes may well be used in the presentation of a wealth of understandable and meaningful problem materials. More generally, we may list the following as indicative of the more widely advocated principles and methods with regard to the formulation and presentation of problem materials:[24]

1. Exercises in the reading of problems should be given, developing the following skills as listed by Newcomb, Stevenson, and Wilson and quoted by Brueckner and Melby (110):[25]
   a. Ability to tell what facts are given.
   b. Ability to tell what question the problem asks.
   c. Ability to select essential facts.
   d. Ability to estimate answers.
   e. Ability to tell how to check answers.

[24] See references 36, 82, 96, 100, 108, 109, 110, 111, 126, 127, 140, 194, 210, 258, 259, 299, 300, 309, 340, 396, 397, 422, 423, 428, 439, 440, 444, 453, 454, 471, 472, 473, 482, 501, 505, 544, 578, 604, 627, 647, 651, 652, 660, 662, 663, 668, 669, 670, 674, 692.

[25] Brueckner, L. J., and Melby, E. O. *Diagnostic and Remedial Teaching.* Houghton Mifflin Co., Boston, 1931. p. 227.

f. Ability to name [more important, we believe, would be ability to recognize] the process to use in one-step problems.
g. Ability to name the process to use in two-step problems.
h. Knowledge of vocabulary.
i. Knowledge of essential denominate numbers and units of measure.
j. Knowledge of essential principles and concepts.
k. Ability to judge absurdities.
l. Ability to check true and false statements.
m. Ability to assemble essential data.
n. Ability to read accurately and exactly.
o. Ability to follow directions.
p. Ability to attack the solution of a problem in a systematic manner.

[Inskeep (300) suggests the following questions to this end for the pupil to ask himself:

(1) What facts does the problem give?
(2) What does it ask me to find out?
(3) What should I do with the facts that are given in order to find out what is wanted?]

q. Ability to apply processes in local situations.
r. Ability to interpret tables found in reference books.
s. Ability to use the index, table of contents, etc., as aids in studying.
t. Ability to understand quantitative concepts in map reading.
u. Range of information in application of arithmetic.
v. Ability to make analogies.
w. Ability to answer specific questions about problems.
x. Ability to formulate problems from given data.
y. Ability to illustrate uses of processes.
z. Ability to detect clues in solving problems.
aa. Knowledge of historical background.
bb. Ability to restate a problem in the words of the pupil.

2. Lists of general sources of widespread error in problem-solving should be used, such as those of Banting (36), John (309), Klapper (340), Morton (439), and others, pointing out flaws in abilities such as those noted above, together with such factors as failure to read all of the problem, disturbance caused by preconceived ideas, and reading between the lines.

3. Large numbers in problems should be avoided. With the low-ability student numbers should probably not exceed four or five integers.

4. Problems involving many steps should be avoided, especially with low-ability students. Evidence has been presented that nearly 80 per cent of all problem situations in real life need but one step in their solution.

5. The story element within the problem should always be concretely related to and arise out of familiar, everyday experiences in the life of the students involved. Unfamiliar or fantastic situations should be presented, if at all, frankly as puzzles.

6. It is very effective to use problems formulated by pupils and teachers working together.

7. The arithmetic facts should always be presented in the form in which they commonly appear in such real-life situations.

8. In training students to read problems, rereading sentence by sentence, translating the various facts stated in terms of the unknown literal number, etc. should be stressed.
9. Accuracy rather than speed must ever be stressed in problem-solving, especially with regard to low-ability students.
10. The attention should be focused upon the numbers in the problem as guides rather than upon the conditions of the problem. With low-ability students it is best to use every number stated in the problem in the actual solution, generally avoiding irrelevant data and extraneous detail.
11. Students should not be allowed to be misguided by certain verbal signs, e.g., a student may well answer "70" to the problem, "if a boy had 210 marbles and lost ⅓ of them, how many had he left?" since the student has been told that whenever he sees "of" after a fraction in a problem, he is to multiply.
12. Many stores price merchandise by the article or group of articles. In handling the buying or selling of a number of articles, unless the number is an even multiple of the group, the group price is used as a basis for part of the costs, and the price per article for the remainder. More problems along this line should be given students in the schools.
13. Visual aids should be used wherever possible to show the workings of problem materials.
14. There has been little agreement concerning the superiority of various methods such as either the "dependencies" or the "individual" methods. It has been demonstrated, however, that the "conventional formula" method is least effective in obtaining results, especially with low-ability students.
15. Specific type problems have been shown to be more readily understandable than general type problems, especially with low-ability students.
16. Conventional type problems seem generally more effective than imaginative type problems, especially when time limitations play a dominant part in the learning situation.
17. Detailed analytical questions on problems, preferably asked orally with slow students, have been shown to be an aid to students.
18. Problem materials should be selected for the practice of recently acquired skills and should include materials providing constant and cumulative review over all past learning.
19. It would be advisable for the teacher, in attempting to trace difficulties with problem-solving, to have a student declare what he thinks the problem means and asks for, and how he would go about solving it. By skillful questioning the teacher can then get to the root of the difficulty and clear it up by careful explanation.
20. More difficult problems should be introduced only a few at a time, well interspersed with problems of less difficulty.

21. The pupil should be encouraged to identify himself with the person whom the problem represents as engaged in some activity requiring mathematical computations.
22. The structure of problems should be logical and orderly and should approximate as closely as possible the way the situation described might happen in reality.
23. Special training in any generalized, formal technique for analyzing problems is not particularly effective. Correct attack on problems may well be more effectively directed through an extensive and broad program offering the student a great wealth of varied problems and problem situations.
24. The practical application of arithmetic in industrial science and domestic science laboratories should be encouraged as much as possible with low-ability students.

Miscellaneous Teaching Devices

In concluding this chapter, it may be well to list as suggestive of the wealth of teaching devices and activities which may be used to make the mathematics program more interesting, meaningful, and profitable, various means suggested to this end as found in the literature.[26] These would be mainly of use in the teaching of the fundamentals and the presentation and formulation of problem materials after the concept of number has been established within the student. Such a list might include the following items:

1. Using number experiences in domestic science, as in measurements required in the following of recipes, cutting out of materials for dresses, figuring the cost of articles made or foods prepared, etc.
2. Using number experiences in projects such as gardening, figuring out cost of seeds and upkeep, figuring prices at which produce must be sold, etc.
3. Using number experiences in industrial arts in measurement of various objects made and the cost of articles constructed, etc.
4. Estimating possible costs of equipping or remodeling the classroom, the playground, the gymnasium, the laboratory, etc.
5. Using number experiences in keeping scores and averages in various sports and games, either intermural or intramural in nature, or following the course of favorite athletes on professional teams.
6. Using problems concerned with temperature, maintaining even heat in summer and winter, etc.
7. Using various puzzles, magic squares, etc.

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[26] See references 8, 11, 21, 26, 29, 53, 55, 56, 60, 65, 68, 69, 78, 88, 110, 126, 127, 130, 135, 140, 151, 161, 162, 163, 164, 178, 185, 204, 234, 250, 260, 263, 267, 278, 293, 295, 299, 300, 306, 315, 340, 349, 362, 371, 374, 381, 387, 390, 393, 394, 396, 397, 398, 409, 430, 432, 435, 459, 461, 482, 491, 512, 515, 521, 525, 530, 531, 548, 549, 550, 554, 557, 567, 585, 591, 595, 602, 611, 626, 632, 633, 650, 655, 663, 668, 671, 675, 686, 703, 705.

8. Using various original or copyrighted plays and similar dramatic material.[27]
9. Exploiting to the fullest the extracurricular activities of students. This would include using number situations arising in having a paper route, paying carfare to and from school, buying lunches, spending money on the theater over a period of time, etc.
10. Making excursions to places of business which would demonstrate the importance of mathematics in daily life, for example, to a bank, clearing house, stock brokerage office, department store, time-keeping office in a factory, etc.
11. Using actual business forms as checks, invoices, receipts, time cards, tax receipts, price tags, etc.
12. Using advertising layouts for newspapers and magazines, indicating prices, reductions, discounts, etc. Using mail-order catalogues and figuring cost of imaginary bills of goods one might buy.
13. Using number experiences involved in various school projects, such as buying and selling tickets for plays, games, music recitals, etc.; school banking; selling supplies in the school store, etc. These activities should be carried out with the students in key positions wherever possible.
14. Using games involving number experiences, such as lotto, monopoly, dominoes, bingo, etc.
15. Using number activities involved in a safety campaign, estimating safe speeds, distances to watch in estimating approach of vehicles, etc., or the activities involved in a clean-up campaign, estimating costs of hauling rubbish from some eyesore, repainting the garage, repairing a porch, etc.
16. Exploiting hobbies, estimating the cost of stamps, athletic equipment, dolls, materials for woodwork, etc.
17. Building models out of cardboard, wood, soap, and similar materials with regard for scale.
18. Drawing maps, charts, etc. with regard for scale.
19. Estimating costs of living in other countries and other periods of history on the basis of currencies and standards of living other than our own. Many of such activities may well be executed in coöperation with such subject-matter areas as English, history, geography, Latin, etc.
20. Using exercises in budgeting, planning diets, figuring expenses for various extracurricular activities, etc.
21. Taking an imaginary trip throughout the United States, computing distances, cost of gas and oil, cost of food and shelter, allowance for recreation, etc.

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[27] Plays such as the following which have appeared at various times in *The Mathematics Teacher* may be used at various levels throughout the school:
Brownell, Ella. "Mathesis." 20:459-65, December, 1927.
Hatton, Caroline, and Smith, Doris H. "Falling in Love with Plain Geometry." 20:389-402, November, 1927.
Pitcher, Wilimina E. "Alice in Dozenland." 27:390-6, December, 1934.
Skerrett, Josephine. "A Mathematical Nightmare." 22:413-17, November, 1929.
Smith, Alice K. "The Case of Matthew Mattix." 26:286-91, May, 1933.

22. Meeting with salesmen who have services or goods to sell to the school, comparing prices, etc.
23. Establishing a coöperative store in the school.
24. Having mathematics exhibits, creating posters, setting up a mathematics museum, etc.
25. Tracing the history of mathematics, noting superstitions concerning number, origin of numerals, etc.
26. Recommending books for corollary reading dealing with great mathematicians, or telling stories concerning constructions involving mathematics.
27. Writing poems, essays, etc., on mathematical subjects.
28. Inventing original mathematical puzzles, magic squares, etc.
29. Noting the mathematics in architecture, nature, music and musical instruments, furniture, clothing, house construction, etc.
30. Noting mathematical terms found in the Bible.
31. Taking an inventory of stock in the school store, laboratory, kitchen, etc.
32. Planning a flag for a patriotic holiday, planning formations for pageants for such events, etc.
33. Estimating the cost of running the family car, electric refrigerator, gas stove, etc.
34. Estimating the cost of a vacation trip or school excursion.
35. Helping with class attendance records, the distribution of books and materials, etc.
36. Recording time spent on music lessons, recreation, school, sleep, etc. during the week.
37. Using the mathematical implications of the vocations of the parents of the children.
38. Floating an imaginary company to buy out the stamp club, or some similar enterprise.
39. Compiling statistics such as the local accident rate, community gas consumption, etc.
40. Getting the coöperation of the publicity departments of famous companies to help with exhibits, excursions, demonstrations, etc.

CHAPTER VII

CONCLUSION

Mathematics as an area of widespread failure, not only among low-ability students but also among normal and even brilliant students (in other subject-matter areas), is justly a cause for concern among educators. Before the problem can be studied thoroughly, it is necessary to have clearly in mind what is meant by the low-ability student. How is he different from the normal and brilliant student? How are we to regard students who are exceptionally skilled in other branches of learning, but who fail miserably in mathematics? Some of the major factors generally observable in low-ability students have been listed, among them being low mentality, social and emotional maladjustment, physical handicaps, and educational retardation.

With the fact in mind that these influences as well as end-results are correlated with each other and retroactive one upon the other, we have attempted to formulate a working definition of the low-ability student. According to this definition, a low-ability student is one who, owing to low mentality, physical disability, emotional or social maladjustment, improper pedagogical procedures, or a combination of any or all of these together with many other possible contributory factors, fails to achieve certain standards in any one subject or group of subject-matter areas, when those standards have been fixed on the basis of the best available evidence resulting from objective, validated research on placement, evaluation, intelligence testing, etc., and when the objectives of the program are geared to the fullest possible consideration for the continuous and cumulative growth of each individual in terms of the interests, abilities, tastes, and immediate and potential personal and social needs of the individual student involved. Under the terms of such a definition, a student who fails in a program in which his abilities and needs are not considered has not failed at all; but, rather, the school has failed in its duty to the student. The definition further indicates that low ability is not necessarily general; that a student may be an "A" student in English and a "B" student in geography, and still be a low-ability student in mathematics if he fails to achieve in that subject in terms of the definition.

The first step in any educational effort on the behalf of the low-ability student would, of necessity, be the task of recognizing such a student so that special attention could be given to him in the light of his capacities and needs. To this end a comprehensive, intelligent, and scientific testing program should be instituted, and every possible means of evaluation from reliable and valid tests to more informal but valuable observational techniques should be used in order to give as full a picture as possible of the individual student with his individual capacities and failings. Remedial and regular instructional procedures may be intelligently and economically based upon the results of such a program, in terms of the objectives of the elementary school in the matter of mathe-

matics in general and of the objectives for teaching this subject matter to low-ability students in particular.

After the low-ability student has been identified, the most widely advised general methodology is to place him in a homogeneous group where he is on the level with persons approximating his own capacities and needs. "Homogeneous" grouping, in this study, has been defined as a device whereby students of similar abilities, tastes, interests, and needs are placed in groups with students with similar capacities and needs for the purpose of administering, educationally, a program which would take their individual differences into consideration and would allow for the fullest possible continuous and cumulative emotional, physical, and intellectual growth of each student for the greatest good to himself and to the greatest number within the social group.

After the low-ability student has been identified and placed in homogeneous groups, the chief problem is that of adjusting the curriculum and methods of the school to his individual capacities and needs. The entire testing program and the grouping plan will fail completely if, despite the findings of the former and the provisions in the administrative setup of the latter, the methods and materials of instruction remain absolute and unchangeable for all students and on all levels. Flexibility and informality in terms of individualism must ever be the watchword, especially in the case of low-ability students. To attain this flexibility and informality with regard to these students, the following major general means have been noted: less coverage of ground; simplification of methods and materials; setting of minimum essentials; provision of special coaching and instruction in methods of study; use of unit plans and class projects; and, finally, institution of a more flexible means for reporting progress to students and parents, and for making promotions.

To effect the desired flexibility and informality of methods and materials in order to develop as fully as possible the growth of the low-ability student in accordance with his capacities and needs, certain general procedures are advocated. All materials for such students should be particularly highly motivated since such students are usually handicapped by a short attention span and a marked lack of initiative. These students also require repeated instruction to the point of overlearning, with the emphasis ever on complete mastery and accuracy rather than on speed or ground covered.

In view of this necessity for repetition, the need for proper motivation becomes all the more apparent. If such students lose interest in a regular class presentation, how much more less interested will they become when the materials must be repeated at great length. To avoid this waning of interest and to provide proper motivation, materials which are presented must always arise incidentally out of the daily life experiences of the children themselves. The methods and materials of presentation must be highly objective and concrete, since the low-ability student is usually deficient in his powers of comprehending the abstract, especially on the elementary level. Although the materials will seem to rise incidentally and informally from the everyday activities of the children, this will not mean a chaotic, catch-as-catch-can

presentation. Quite the contrary, the method used will require unusually careful planning by an unusually alert teacher with superior background and personal qualities who can exploit the incidental class occurrences and assimilate them into a broadly constructive educational program. The presentation must always be varied and novel to compensate for the necessity for repetition and to make that repetition worth-while. The appeal to the sensory perceptions, which are usually quite active in low-ability students, and to the love of doing things manipulatively by means of games, industrial and domestic science activities, and all kinds of visual and auditory materials has been described as a means for the attainment of the desired variety and novelty in presentation.

Proofs and checking are generally advocated as means of helping the low-ability student achieve mastery and accuracy, while the use of short cuts and crutches, except in unusual cases, is discouraged. With these students drill and review are generally advocated as a means to the repetition necessary to learning, but they must be informal, varied, novel, and suited to the individual differences of the students involved. As with most teaching procedures with slow students, intensive drill rather than extensive should be given over certain minimum essentials which have been demonstrated as useful and contributory to the present and probable needs of the students. Supervised study and special coaching are other devices advocated to this end. It is widely advocated that supervised study completely displace home study with low-ability students.

The vital importance of the regular classroom teacher in his daily and intimate contact with his students cannot be overemphasized. On him resolves the primary necessity for keeping the pupil happy and satisfied. This is particularly important with the low-ability student who frequently suffers from an inferiority complex and maladjustments which make themselves observable in a chronic state of depression. The regular classroom teacher is, of course, to be aided in his work by various other persons and agencies within the school and adjacent and available to it, whose immediate interests are also with the development of school children into useful and constructive citizens. Among these would be visiting teachers, supervisory teachers, administrative school officials, doctors, dentists, psychologists, nurses, and social workers, and such facilities as community settlement houses, playgrounds, psychological clinics, etc. All of these agencies working together must institute and execute a comprehensive program of mental hygiene and physical and health education. They must minimize or eliminate, as far as possible, the health handicaps of children which are contributory to retardation.

With low-ability students, it is generally advisable that the day be broken up into shorter periods, while the school day itself be lengthened to allow for supervised study and play. This is particularly important with these students, since many of them come from environments which are conducive to neither constructive nor healthful home study and play. A minimum period length of ten minutes and a maximum length of thirty minutes have been widely recommended. If the length-

ened school day or week is instituted, ample provision should be made for fatigue, since low-ability students usually tire easily, and the day and week should be freely interspersed with recreational periods. Morning classes for work demanding more concentrated attention are advocated and, since mathematics seems to be such a generally troublesome area, it is advocated that, where separate subject-matter periods prevail, the number work be taught in the early morning.

Not too much dependence should be placed upon textbooks with low-ability students who require concrete, objective, and manipulative activities for most effective learning. However, textbooks that are well chosen for educational soundness and attractiveness may well be used to good effect. The other physical aspects of education, such as the school plant and equipment, should be ample and modern. There must be an abundance of machinery and supplies to make possible the highly varied and concrete presentation of materials to the low-ability student.

In the teaching of arithmetic, it is generally advisable to delay the formal teaching of number to low-ability students until the third grade. Preceding this more or less formal attack of the fundamentals on that level, full time should be spent in the development of the child's concept of arithmetic or his number sense. The teaching at this level should be seemingly incidental in arising from the everyday, real-life experiences of the youngsters themselves. The child's wealth of number experiences and knowledges acquired in his preschool training should be capitalized upon as fully as possible. Not until this sense of number has been developed, should one proceed to the teaching of the fundamentals which are all-essential in the learning of number in the elementary school experiences of low-ability students. Myriad devices to attain this end have been described and may be created. With number especially, complete mastery and accuracy rather than speed and ground covered must be the main concern of the teacher of the slow student.

Concerning the placement of the fundamentals, the following order has been advised: (1) addition, (2) multiplication, (3) subtraction, and (4) division. With regard to the teaching of common fractions after division, note has been made of the growing trend to teach decimal fractions before common fractions with students of low ability. It has been noted that neither upward nor downward addition has been shown to be decidedly superior, and it has been advised that one method be taught for adding, and the other for checking. The method of teaching multiplication upwards is generally advisable. In subtraction it is generally advised that the "take-away borrowing-upward" method be used with low-ability students, with emphasis on the use of the phrases "take away" and "how many have I left?" It is inadvisable to try to teach addition together with subtraction to slow students. Multiplication of fractions seems to be the process most readily learned, and should be taught first after division, unless decimal fractions are used as an introduction to common fractions. Multiplication of fractions should be followed by division, addition, and finally subtraction, in that order. Problem materials should deal with familiar situations, have relatively few steps, and be of the conventional rather than imaginative type.

The close relationship between vocabulary and reading ability and the ability to master problem arithmetic has been noted. Written problem materials should not be introduced until a reasonable mastery of the fundamentals and the ability to read has been achieved, and the complications which a word vocabulary adds to the need for an adequate number vocabulary should be avoided as far as possible. Such are some of the main recommendations with regard to the teaching of arithmetic specifically to low-ability students in the elementary school.

This chapter has not attempted to detail all of the points noted throughout the survey. At best, it has suggested only the main points which have been brought out. The supporting evidence and arguments and the advocacy of more specific means to the ends sought must be found in the body of the paper itself.

CHAPTER VIII

PROBLEMS FOR FURTHER RESEARCH

In the course of the making of this survey, a number of important problems worthy of further research were noted. For what a listing of these problems may be worth, we present some of the more important ones as we have found them to exist. They may serve as suggestions for research workers in the field, and may stimulate some of the investigation for which they clamor. Such a listing would be as follows:

1. The need for the perfection of objective testing devices for the measurement of the more subtle and dynamic factors contributing to human personality; e.g., interests, appreciations, attitudes, emotional responses, methods of working and thinking, ability to see associative connections and make well-supported generalizations, etc.
2. The need for objectively substantiated data concerning the most valid and reliable of the tests on the market over any one specific area of evaluation, and the extent to which many of these tests duplicate or complement one another.
3. The need for a great deal more research on the whole matter of readiness and placement, and the establishment of reasonable standards of achievement at various age and grade levels on the basis of biological, psychological, and physiological readiness.
4. The need for the establishment of a more definite understanding of the place and operation of zero in scoring.
5. The need for more effective devices to determine the importance of such factors as reading ability in arriving at the establishment of I.Q.'s, on the basis of the results of intelligence testing.
6. The need for the setting of standards for the more adequate consideration of mental maturity in the establishment of I.Q.'s and groupings on the basis of I.Q.'s.
7. The need for the setting of more objectively determined standards for the I.Q. boundaries of the various mental groups; e.g., brilliant, normal, borderline, and subnormal; and the resultant general acceptance of these demarcations.
8. The need for determining more objectively the relationships between "emotional" and "social" maladjustment noting in what ways they are retroactive one upon the other; specifically, wherein lie the differences between pupils of exceptionally high I.Q.'s and others with exceptionally low I.Q.'s who apparently exhibit the same observable symptoms of maladjustment.
9. The need for an accurate statistical study to determine the number of students who fail in mathematics throughout the various school levels while successfully mastering other bodies of subject matter.
10. The need for some valid and objectively substantiated explanation of the above-cited phenomenon.

11. The need for scientifically established standards of achievement for students on all mental levels, in accordance with their actual present and potential needs. With regard to low-ability students, this would necessitate setting objective standards validated by research concerning the establishment of minimum essentials for them.
12. The need for validation of the placement of multiplication rather than subtraction after addition, on the basis of controlled experiments.
13. The need for determining the value of placing the teaching of decimal fractions before common fractions, on the basis of controlled experiments.
14. The need for determining the teaching of multiplication of common fractions first in teaching fractions generally, on the basis of controlled experiments.
15. The need for validating scientifically the postponement of the teaching of the fundamentals as such until some time after the entry of students upon their formal schooling careers.
16. The need for a great deal more research concerning the operation of the mental processes of children in attacking mathematics problems, based on their verbalized mental processes.
17. The need for determining more scientifically the degree of support and re-enforcement which incidental and preschool learning experiences contribute to regular instruction.
18. The need for more valid information than is now available on the basis of controlled experiments concerning the value of crutches in instruction.
19. The need for more scientifically established information concerning student interests on various age and grade levels.
20. The need for more scientifically established techniques for the integration of arithmetic with the other work of the schools.
21. The need for determining more scientifically the true psychology of success and failure.
22. The need for the scientific determination of what degree of mastery can be counted as success on various age and grade levels, on the basis of controlled experiments.
23. The need for the more scientific determination of the importance of a learning experience and its relation to the time element involved in its learning.
24. The need for the more scientific determination of the part played by the teacher's personality, understanding, and interest in the resultant interest and success of the student involved.
25. The need for more scientifically validated conceptions concerning teacher load, with more regard for such factors as the individual teacher's background, capacity for work, health, etc.
26. The need for more scientifically established information concerning the most efficient class size, length of class periods, length of class

day, and the distribution of various subject-matter areas for learning throughout the day.

27. The need for the more scientific establishment of the claimed superiority of supervised study over home study.
28. The need for scientifically determined data concerning the re-enforcement and support of extracurricular activities in bolstering the social needs of low-ability students divided into homogeneous groups.
29. The need for the establishment, on the basis of scientific evidence, of more widely acceptable objectives for the teaching of arithmetic from the elementary level on throughout the school to provide for a more meaningful continuous and cumulative set of learning experiences in this subject-matter area.

BIBLIOGRAPHY

1. Abelson, Harold Herbert. "Achievement of Dull Pupils under the Dalton Plan." *School and Society* 30:211-12, August 10, 1929.
2. Adams, Waldo Loren. "Why Teachers Say They Fail Pupils." *Educational Administration and Supervision* 18:594-600, November, 1932.
3. Adler, A. "Wass Kann die Individual-Psychologie zur Mathematischen 'Begabung' Sagen?" *Internazionalische Zeitschrift fur Indiv.-Psychologie* 11:42-3, 1933.
4. Allen, J. Ell. "Some Psychological Phases of Student Success in High School Mathematics." *Mathematics Teacher* 30:322-5, 1937.
5. Allen, Rufus B. As reported in *Elementary School Journal* 36:496, March, 1936.
6. Allen, W. Paul. "A Program of Teacher Home Visitation." As reported in *Elementary School Journal* 38:247-9, December, 1937.
7. Almack, John Conrad. "The Teacher's Load as a Factor in Physical and Mental Hygiene." *Bulletin of the Department of Elementary School Principals* 15:368-72, July, 1936.
8. Amoss, Harry. "Special Education in Rural Communities." *Journal of Exceptional Children* 5:73-5, 93, January, 1939.
9. Anderson, Harold Homer. *School-Home Co-operation.* Child Welfare Pamphlets No. 15, University of Iowa, Iowa City, December, 1932. 11 pp.
10. "Conflicts in Personality Development." *Mental Hygiene* 20:605-13, October, 1936.
11. Anderson, Meta Louise. *Education of Defectives in the Public Schools.* World Book Co., New York, 1922. 104 pp.
12. "Why Special Classes?" *Mental Hygiene* 15:87-100, January, 1931.
13. "The Problem of the Mentally Retarded Children in the Public Schools." *Journal of Educational Sociology* 6:348-53, February, 1933.
14. Anderson, Rose G. "The Problem of the Dull-Normal Child." *Mental Hygiene* 11:272-86, April, 1927.
15. Anderson, Victor Vance, and Kennedy, W. M. *Psychiatry in Education.* Harper Bros., New York, 1932. 430 pp.
16. Andrew, Dorothy Mabel, and Bird, Charles. "A Comparison of Two New Type Questions: Recall and Recognition." *Journal of Educational Psychology* 29:175-93, March, 1938.
17. Anton, Willadene. "Types of Report Cards in Use." *School Executives Magazine* 54:332-3, 346, July, 1935.
18. Arlitt, Ada Hart. "Your Child Enters School for the First Time." *Parent Education*, pp. 99-106. Fourth Yearbook, National Congress of Parents and Teachers, Washington, D.C., 1934.
19. Arps, George F. *Work with Knowledge of Results Versus Work without Knowledge of Results.* Psychological Review Monographs, Vol. 28, No. 3 (Whole No. 125), Psychological Review Co., Princeton, N.J., 1920. 41 pp.
20. Arthur, Grace. "A Quantitative Study of the Results of Grouping First-Grade Classes According to Mental Age." *Journal of Educational Research* 12:173-85, October, 1925.
21. Astor, Frank. "Emotional Needs of the Exceptional Child." In *Exceptional Child at Home and at School*, pp. 11-17. Child Research Clinic, Pt. II, Langhorne, Pa. 1937.
22. Athens, Ida G. "The Activity Program for Mental Defectives." *Ohio Schools* 14:124, 157, April, 1936.
23. Austin, C. M. "Suggestions for Teachers of Mathematics." *Mathematics Teacher* 30:360-2, December, 1937.
24. Averill, Lawrence Augustus. *The Hygiene of Instruction; A Study of the Mental Health of the School Child.* Houghton Mifflin Co., Boston, 1928. 386 pp.
25. Ayres, Leonard Porter. *Laggards in our Schools.* Survey Associates, Inc., New York, 1913. 236 pp.
26. Bachelard, P. Moliter. *The Education of the Retarded Child.* Melbourne University, Educational Research Series No. 26, Melbourne, 1934. 86 pp.
27. Bagley, William C., and Kyte, George C. "Failures in Reading and Arithmetic." As reported in *Elementary School Journal* 27:411-13, February, 1927.

28. Bain, Read. "The Validity of Life Histories and Diaries." *Journal of Educational Sociology* 3:150-64, November, 1929.

29. Baker, Harry Jay. *Characteristic Differences in Bright and Dull Children.* Public School Publishing Co., Bloomington, Ill., 1927. 118 pp.

30. *Educational Disability and Case Studies in Remedial Teaching.* Public School Publishing Co., Bloomington, Ill., 1929. 172 pp.

31. "The Psychology of Ability Groups and Implications for Instructional Differentiation." *Yearbook of the National Society for the Study of Education* 35 (Pt. I):135-60, 1936.

32. "Mathematics and Intellectual Abilities." *Mathematics Teacher* 30:259-64, October, 1937.

33. Baker, Harry J., and Traphagen, Virginia. *The Diagnosis and Treatment of Behavior-Problem Children.* The Macmillan Co., New York, 1936. 393 pp.

34. Ballenger, H. L. "Overcoming Some Addition Difficulties." *Journal of Educational Research* 13:111-17, February, 1926.

35. Bamberger, Florence E. "A Survey of Observable, Improvable Factors Which Evidence Skill in Teaching." *Elementary School Journal* 28:181-5, November, 1927.

36. Banting, G. O. "The Elimination of Difficulties in Reasoning." *Yearbook of the Department of Elementary School Principals* 2:411-21, 1923. Summarized in *Diagnostic and Remedial Teaching*, by Leo John Brueckner and Ernest O. Melby, Ch. VII, pp. 230-3. Houghton Mifflin Co., Boston, 1931.

37. Barthelmess, Harriet May, and Boyer, P. A. "An Evaluation of Ability Grouping." *Journal of Educational Research* 26:284-94, December, 1932.

38. Bassett, Clara. *The School and Mental Health.* The Commonwealth Fund, Division of Publications, New York, 1931. 76 pp.

39. "Utilizing Specialized Assistance Outside the School." *Bulletin of the Department of Elementary School Principals* 15:581-6, July, 1936.

40. Beal, Ross H. "What Is Good Fraction Drill?" *Elementary English Review* 6:49-52, February, 1929.

41. Beatty, Willard W. "The Additive Versus the Borrowing Method of Subtraction." *Elementary School Journal* 21:198-200, November, 1920.

42. Bedford, Fred L. "Planning the Mathematics Classroom." *The School Executive* 55:290-2, April, 1936.

43. Beeson, Marvin F., and Tope, Richard E. "The Educational and Accomplishment Quotients as an Aid in the Classification of Pupils." *Journal of Educational Research* 9:281-92, April, 1924.

44. Beke, E. "Ueber Mathematische Begabung." *Internazionalische Zeitschrift fur Indiv.-Psychologie* 11:33-41, 1933.

45. Benedict, Agnes E. *Children at the Crossroads.* The Commonwealth Fund, Division of Publications, New York, 1930. 238 pp.

46. Bennett, Annette. *A Comparative Study of Subnormal Children in the Elementary Grades.* Columbia University, Teachers College, Contributions to Education No. 510, New York, 1932. 81 pp.

47. Bennett, E. "Integration of Arithmetic in the Upper Elementary Grades." *Virginia Journal of Education* 28:255-7, March, 1935.

48. Bentley, John Edward. *Problem Children: An Introduction to the Study of Handicapped Children in the Light of Their Physiological, Psychological and Social Status.* W. W. Norton and Co., New York, 1936. 437 pp.

49. Berne, Mrs. Esther (Van Cleave). *Educating the Handicapped.* University of Iowa, Child Welfare Pamphlets No. 12, Iowa City, 1932. 11 pp.

50. Bernhardt, Karl S., and Herbert, Ruth. "A Further Study of Vitamin B Deficiency and Learning with Rats." *Journal of Comparative Psychology* 24:263-7, August, 1937.

51. Berry, Charles Scott. "The Classification by Tests of Intelligence of Ten Thousand First-Grade Pupils." *Journal of Educational Research* 6:185-203, October, 1922.

52. "The Aims and Methods of Education as Applied to Mental Defectives." *Proceedings and Addresses of the American Association for the Study of the Feeble-Minded* 35:68-72, 1930.

53. *Special Education, the Handicapped and Gifted.* White House Conference on Child Health and Protection. The Century Co., New York, 1931. 604 pp.

54. "Public School Education of Mentally Retarded Children." *Proceedings of the American Association for Mental Defectives* 40:111-30, 1936.

55. *How the Teacher May Help the Exceptional Child.* Ohio State University, Columbus, Ohio. 23 pp.

56. Berry, Charles Scott, *et al.* *A Survey and Program for Special Types of Education.* Trenton, N.J., June, 1929.

57. Betts, George Herbert. "Teachers' Diagnosis of Classroom Difficulties." *Elementary School Journal* 27:600-8, April, 1927.

58. Bieth, P. "Le Rendement Scolaire et Social d'une École d'Arriérés." *Journal Psych. Norm. Path.* 34:265-91, 1937.

59. Bigelow, Elizabeth B. "The School Progress of Under-Age Children." *Elementary School Journal* 35:186-92, November, 1934.

60. Binet, Alfred, and Simon, Th. *Mentally Defective Children.* Longmans Green and Co., New York, 1914. 164 pp.

61. Blaisdell, Walter H. "A New Idea for Review Work." *Mathematics Teacher* 23:438-41, November, 1930.

62. Blankenship, Albert B. "Effect of Praise and Reproof upon Memory Span Performance." *American Journal of Psychology* 51:527-31, July, 1938.

63. Blatz, William Emet. *The Importance of Failure.* University of Iowa, Child Welfare Pamphlets No. 45, Iowa City, December 8, 1934. 10 pp.

64. Bonar, Hugh S. "Ability Grouping in the First Grade." *Elementary School Journal* 29:703-6, May, 1929.

65. Bond, Elias Austin. *The Professional Treatment of the Subject Matter of Arithmetic for Teacher-Training Institutions.* Columbia University, Teachers College, Contributions to Education No. 525, New York, 1934. 315 pp.

66. "Recent Changes in Point of View Relating to the Teaching of Arithmetic." *Mathematics Teacher* 30:175-9, April, 1937.

67. Booker, Ivan A. "The Child Who Is a Misfit." *Elementary School Journal* 29:140-6, October, 1928.

68. *The Boston Way.* Rumford Press, Concord, N.H., 1921. 142 pp.

69. Botsford, Stephen J. "Real Life Experiences in the School." *Mathematics Teacher* 26:40-5, January, 1933.

70. Bowden, A. O. "What Arithmetic Is to Be Taught?" As reported in *Elementary School Journal* 30:168-70, November, 1929.

71. Boynton, Paul Lewis, and McGaw, Bonnie H. "The Characteristics of Problem Children." *Journal of Juvenile Research* 18:215-22, October, 1934.

72. Branom, Mendel E. "The Value of the Project Problem Method in Elementary Education." *Elementary School Journal* 18:618-22, April, 1918.

73. Breed, Frederick Stephen. "Measured Results of Supervised Study." *School Review* 27:186-204, March, 1919; 262-84, April, 1919.

74. Breed, Frederick Stephen, and Ralston, Alice L. "The Direct and Indirect Methods of Teaching the Addition Combinations." *Elementary School Journal* 37:283-94, December, 1936.

75. Breidenstine, A. G. "The Educational Achievement of Pupils in Differentiated and Undifferentiated Groups." *Journal of Experimental Education* 5:91-135, September, 1936.

76. Brenner, Benjamin. *Effect of Immediate and Delayed Praise and Blame upon Learning and Recall.* Columbia University, Teachers College, Contributions to Education No. 620, New York, 1934. 52 pp.

77. Breslich, E. R. "Supervised Study as a Means of Providing Supplementary Individual Instruction." *Yearbook of the National Society for the Study of Education* 13 (Pt. I):32-72, 1914.

78. Bridie, Marion F. *An Introduction to Special School Work.* Edward Arnold, London, 1917. 238 pp.

79. Brinkerhoff, George I. "A Study of Pupil Failure in New Jersey." As reported in *Elementary School Journal* 36:493-6, March, 1936.

80. Broady, Knute Oscar. *School Provision for Individual Differences; Policies and Data Necessary.* Columbia University, Teachers College, Contributions to Education No. 395, New York, 1930. 101 pp.

81. Brodsky, P. "Psychologie des Nachhilfeunterrichts." *Internazionalische Zeitschrift fur Indiv.-Psychologie* 13:88-104, 1935.

82. Brooks, Harry. *Problem Arithmetic.* Little, Brown and Co., Boston, 1923. 332 pp.

83. Broom, Eustace, and Trowbridge, Bertha. "The Visiting Teacher's Job." *Elementary School Journal* 26:653-61, May, 1926.

84. Brown, Andrew Wilson. *The Unevenness of the Abilities of Dull and Bright Children.* Columbia University, Teachers College, Contributions to Education No. 220, New York, 1926. 112 pp.

85. Brown, Francis James. "Knowledge of Results as an Incentive in School Room Practice." *Journal of Educational Psychology* 23:532-52, October, 1932.

86. Brown, Joseph Clifton. "A Summary of Some Significant Conclusions Reached by Investigators Relative to Arithmetic." *Elementary School Journal* 25:346-57, January, 1925.

87. Brown, Warner. "Punishment Does Work." *Journal of Comparative Psychology* 24:145-6, August, 1937.

88. Brownell, William Arthur. *The Development of Children's Number Ideas in the Primary Grades.* University of Chicago Press, Supplementary Educational Monographs No. 35, Chicago, 1928. 241 pp.

89. "Remedial Cases in Arithmetic." *Peabody Journal of Education* 7:100-7, September, 1929.

90. "The Place of 'Crutches' in Instruction." *Elementary School Journal* 34:607-19, April, 1934.

91. "Psychological Considerations in the Learning and the Teaching of Arithmetic." In *The Teaching of Arithmetic*, pp. 1-31. (Tenth Yearbook of the National Council of Teachers of Arithmetic.) Columbia University, New York, 1935.

92. "Readiness and the Arithmetic Curriculum." *Elementary School Journal* 38:344-54, January, 1938.

93. "A Critique of the Committee of Seven's Investigations on the Grade Placement of Arithmetic Topics." *Elementary School Journal* 38:495-508, March, 1938.

94. "Two Kinds of Learning in Arithmetic." *Journal of Educational Research* 31:656-64, May, 1938.

95. Brownell, William Arthur, and Chazal, C. B. "The Effects of Premature Drill in Third-Grade Arithmetic." *Journal of Educational Research* 29:17-28, September, 1935.

96. Brownell, William Arthur, and Stretch, L. B. *The Effect of Unfamiliar Settings on Problem-Solving.* Duke University Press, Duke University Research Studies in Education, No. 1, Durham, N.C., 1931. 86 pp.

97. Brueckner, Leo John. "Certain Arithmetic Abilities of Second-Grade Pupils." *Elementary School Journal* 27:433-43, February, 1927.

98. "Analysis of Errors in Fractions." *Elementary School Journal* 28:760-70, June, 1928.

99. "Analysis of Difficulties in Decimals." *Elementary School Journal* 29:32-41, September, 1928.

100. *Diagnostic and Remedial Teaching in Arithmetic.* John C. Winston Co., Chicago, 1930. 341 pp.

101. "The Cumulative Effects of the Policy of Non-Failing." *Journal of Educational Research* 28:289-90, December, 1934.

102. "Persistency of Error as a Factor in Diagnosis." *Education* 56:140-4, November, 1935.

103. "Pedagogical Factors Associated with Learning Difficulty." *Yearbook of the National Society for the Study of Education* 34:49-62, 1935.

104. "The Principles of Developmental and Remedial Instruction." *Yearbook of the National Society for the Study of Education* 34:189-98, 1935.

105. "Diagnosis in Arithmetic." *Yearbook of the National Society for the Study of Education* 34:269-302, 1935.

106. "General Methods: Educational Diagnosis." *Yearbook of the National Society for the Study of Education* 37 (Pt. II):333-40, 1938.

107. Brueckner, Leo John, and Elwell, Mary. "Reliability of Diagnosis of Error in Multiplication of Fractions." *Journal of Educational Research* 26:175-85, November, 1932.

108. Brueckner, Leo John, and Irving, J. A. "A Technique for Comparing the Difficulty of Problems in Textbooks in Arithmetic." *Elementary School Journal* 33:283-5, December, 1932.

109. Brueckner, Leo John, and Laumann, G. S. "Measurement of Accuracy of Judgments of the Difficulty of Arithmetic Problems." *Educational Method* 12:338-45, March, 1933.

110. Brueckner, Leo John, and Melby, Ernest O. *Diagnostic and Remedial Teaching.* Houghton Mifflin Co., Boston, 1931. 598 pp.

111. Bruner, Herbert Bascom. "Some Requirements of the Elementary School Curriculum." *Teachers College Record* 39:273-86, January, 1938.

112. Buckingham, Burdette R. "An Experiment in Promotion." *Journal of Educational Research* 3:326-35, May, 1921.

113. "Adding Up or Down: A Discussion." *Journal of Educational Research* 12:251-61, November, 1925.

114. "Teaching Addition and Subtraction Facts Together or Separately." *Educational Research Bulletin* (Ohio State University) 6:228-9, 240-2, May 25, 1927.

115. "The Additive Versus the Take-Away Method of Teaching the Subtraction Facts." *Educational Research Bulletin* (Ohio State University) 6:265-9, September 28, 1927.

116. "Upward Versus Downward Addition." *Journal of Educational Research* 16:315-22, December, 1927.

117. "The Social Value of Arithmetic." (Report of the Society's Committee on Arithmetic) *Yearbook of the National Society for the Study of Education* 29:9-62, 1930.

118. "Trends and Policies in Arithmetic Curricula." *Mathematics Teacher* 31:330-5, November, 1938.

119. Buckingham, Burdette R., and MacLatchy, Josephine. "The Number Abilities of Children When They Enter Grade One." *Yearbook of the National Society for the Study of Education* 20 (Pt. II):473-524, 1930.

120. Buckingham, Guy Emerson. "Relationship Between Vocabulary and Ability in First Year Algebra." *Mathematics Teacher* 30:76-9, February, 1937.

121. Bureau of Research and Guidance, Oakland, California. "Special Classes in Oakland, California." As reported in *Elementary School Journal* 21:648-50, May, 1921.

122. Burge, Lofton V. "The Interview Technique as a Means of Diagnosing." *Journal of Educational Research* 27:422-9, February, 1934.

123. Burnham, William H. "Arithmetic and School Hygiene." *Pedagogical Seminary* 18:54-73, March, 1911.

124. Burr, Marvin Yard. *A Study of Homogeneous Grouping in Terms of Individual Variations and the Teaching Problem.* Columbia University, Teachers College, Contributions to Education No. 457, New York, 1931. 69 pp.

125. Bursch, James Frederick. "Home and Community Conditions Related to Pupil Maladjustment." *Bulletin of the Department of Elementary School Principals* 15:320-3, July, 1936.

126. Burt, Cyril L. *The Subnormal Mind.* Oxford University Press, London, 1935. 368 pp.

127. *The Backward Child.* D. Appleton-Century Co., New York, 1937. 694 pp.

128. Burton, William Henry. *Supervision and the Improvement of Teaching.* D. Appleton-Century Co., New York, 1922. 510 pp.

129. Buswell, Guy Thomas. "The School Treatment of Mentally Exceptional Children." *Elementary School Journal* 23:683-93, May, 1923.

130. "Deferred Arithmetic." *Mathematics Teacher* 31:195-200, May, 1938.

131. Buswell, Guy Thomas, and John, Lenore. *Diagnostic Studies in Arithmetic.* University of Chicago Press, Supplementary Educational Monographs No. 30, Chicago, 1926. 212 pp.

132. Callihan, T. W. "An Experiment in the Use of Intelligence Tests as a Basis for Proper Grouping and Promotions in the Eighth Grade." *Elementary School Journal* 21:465-9, February, 1921.

133. Campbell, Nellie May. *The Elementary School Teacher's Treatment of Classroom Behavior Problems.* Columbia University, Teachers College, Contributions to Education No. 668, New York, 1935. 71 pp.

134. Capron, Virginia Lee. "The Relative Effect of Three Orders of Arrangement of Items upon Pupils' Scores in Certain Arithmetic and Spelling Tests." *Journal of Educational Psychology* 24:689-95, December, 1933.

135. Carr, John W. "A Practical Experiment with Backward Children." In *Journal of Proceedings and Addresses of the National Education Association* 52:844-8, 1914.

136. Carroll, Herbert Allen. *Generalization of Dull and Bright Children: A Comparative Study with Special Reference to Spelling.* Columbia University, Teachers College, Contributions to Education No. 439, New York, 1930. 54 pp.

137. Chase, Vernon Emory. "The Diagnosis and Treatment of Some Common Difficulties in Solving Arithmetic Problems." *Journal of Educational Research* 20:335-42, December, 1929.

138. Christofferson, Halbert Carl. "Trends for Improving Instruction in Mathematics." *Mathematics Teacher* 30:15-20, January, 1937.

139. Clark, John R., and Vincent, E. Leona. "A Study of the Effect of Checking upon Accuracy in Addition." *Mathematics Teacher* 19:65-71, February, 1926.

140. Clark, John Roscoe; Otis, Arthur S.; and Hatton, Caroline. *Primary Arithmetic Through Experience.* World Book Co., New York, 1939. 217 pp.

141. Cline, Jessie M. "Adjusting Algebra to Ability Levels Through the Time Element." *Mathematics Teacher* 22:309-17, October, 1929.

142. Cluley, John Bowie. "A Study of the Relative Amounts of Transfer Resulting from Three Methods of Study." *Journal of Experimental Education* 1:34-42, September, 1932.

143. Cockrell, E. T. "How Absence Affects Quality of Work." *Elementary School Journal* 24:135-7, October, 1923.

144. Colburn, Jessie B. "Organizing Classes for the Slow and Bright Pupils." *Bulletin of the Department of Elementary School Principals* 9:278-85, April, 1930.

145. Colgan, Edward Joseph. "Homogeneous Grouping as an Aid to Teaching." *Harvard Teachers Record* 6:147-54, June, 1936.

146. Collins, Joseph H., and Douglass, Harl R. "The Socio-Economic Status of the Home as a Factor in Success in the Junior High School." *Elementary School Journal* 38:107-13, October, 1937.

147. Colvin, S. S. "Notes on Certain Aspects of Learning." *Psychological Bulletin* 12:67-8, February 15, 1915.

148. Connelley, Russell L. "Diagnostic Tests in Arithmetic." *The Instructor* 44:49, 68, January, 1935.

149. Connor, William L., and Hawkins, Gertrude C. "What Materials Are Most Useful to Children in Learning to Solve Problems." *Educational Method* 16:21-9, October, 1936.

150. Cook, H. M. "Broadening the Basis of Study in Arithmetic." *Mathematical Gazette* 18:192-4, June, 1934.

151. Cook, Mary Ruth. "Stimulating Interest in Mathematics by Creating a Mathematical Atmosphere." *Mathematics Teacher* 24:248-54, April, 1931.

152. Cooke, Martha C. "Individual Work in Algebra." *Mathematics Teacher* 22:361-5, October, 1929.

153. Copeland, Harold W. "Modernizing Mathematics." *Bulletin of the Kansas Association of Teachers of Mathematics* 12:3-5, December, 1937.

154. Cornell, Ethel L. *Mental Hygiene: Its Place in the Classroom.* University of the State of New York, Albany, 1927. 19 pp.

155. "Why Are More Boys than Girls Retarded in School?" *Elementary School Journal* 29:96-105, October, 1928; 213-26, November, 1928.

156. *The Effect of Trait Differences in Ability Grouping.* University of the State of New York, Bulletin No. 981, Albany, 1931. 26 pp.

157. "Effects of Ability Grouping Determinable from Published Studies." *Yearbook of the National Society for the Study of Education* 35 (Pt. I):289-304, 1936.

158. Cornish, William B., and Stark, Julia F. "Organizing Opportunity Classes." *Bulletin of the Department of Elementary School Principals* 9:307-11, April, 1930.

159. Courtis, Stuart Appleton. *Courtis Standard Practice Tests in Arithmetic: Teacher's Manual.* World Book Co., New York, 1917.

160. "The Evolution of Individualization; an Interpretation." *Educational Method* 15:291-308, March, 1936.

161. "Contributions of Research to the Individualization of Instruction." *Yearbook of the National Society for the Study of Education* 37 (Pt. II):201-10, 1938.

162. Cowen, Philip A. "The Social Adjustment of the Special-Class Child." *Journal of Educational Sociology* 5:152-8, November, 1931.

163. Cowen, Philip A., and Matthews, E. R. *Special Class Curriculum Study.* University of the State of New York, Bulletin No. 944, Albany, 1930. 55 pp.

164. Coxe, Warren W. *Organization of Special Classes for Subnormal Children.* University of the State of New York, Albany, 1924. 13 pp.

165. "Our Homogeneous-Ability Grouping Confusion." *Journal of Educational Research* 25:1-5, January, 1932.

166. "The Influence of Pupil Grouping on the Development of Non-Intellectual Qualities." *Proceedings of the Institute for the Exceptional Child* (Child Research Clinic) 3:31-5, 1936.

167. Coxe, Warren W., and Cornell, Ethel L. *A Study of Pupil Achievement and Special Class Needs in Westbury, L.I.* University of the State of New York, Albany, 1926. 52 pp.

168. Crawford, Claude C., and Carmichael, Jacob A. "The Value of Home Study." *Elementary School Journal* 38:194-200, November, 1937.

169. Crider, Blake. "The Effect of Absences on Scholarship." *School and Society* 30:27-8, July 6, 1929.

170. Crooks, A. Duryee. "Marks and Marking Systems: A Digest." *Journal of Educational Research* 27:259-72, December, 1933.

171. Cutright, Prudence Bradford. "A Cumulative Pupil Record Card." *Bulletin of the Department of Elementary School Principals* 15:479-84, July, 1936.

172. Cutright, Prudence Bradford, and Anderson, W. A. *An Experimental Study of Pupil Failures in the First Grade.* Minneapolis Public Schools, Minneapolis, 1934. 40 pp.

173. Dallenbach, Karl M. "The Effect of Practice upon Visual Apprehension in School Children." *Journal of Educational Psychology* 5:321-34, June, 1914; 387-404, September, 1914.

174. "The Effect of Practice upon Visual Apprehension in the Feeble-Minded." *Journal of Educational Psychology* 10:61, February, 1919.

175. Davis, Mary Dabney. "The Primary Unit—An Aid to Children's Progress." *School Life* 24:297-8, 318-19, July, 1939.

176. Demiashkevich, Michael John. "Some Doubts about the Activity Program." *Harvard Teachers Record* 3:170-8, October, 1933.

177. Department of Superintendence of the N.E.A. "Arguments for and Against Homogeneous Grouping." *Yearbook of the Department of Superintendence* 9:121-6, 1931. As reported in *Elementary School Journal* 31:644-9, May, 1931.

178. Descoeudres, A. *The Education of Mentally Defective Children.* D. C. Heath and Co., Boston. 312 pp.

179. DeWitt, Gordon M. *Factors Contributing to Over-Ageness and Slow-Progress in the Crawford County Schools.* Ohio State University, Unpublished Master's thesis, Columbus, 1932. 133 pp.

180. Dexter, Emily Smith. "Does Mathematics Require Specialized Endowment?" *School and Society* 44:220-4, August 15, 1936.

181. Dickey, John Weller. "The Value of Estimating Answers to Arithemetic Problems and Examples." *Elementary School Journal* 35:24-31, September, 1934.

182. Dickter, Morris Richard. "The Problem of Review." *Mathematics Teacher* 31:385-6, August, 1938.

183. Dimmick, Earl A. "An Appraisal of an Elementary School Reorganization in Terms of Its Effect upon the Children Who Attend It." *Journal of Educational Research* 32:91-101, October, 1938.

184. Division of Educational Research and Results of the School District of Philadelphia. "Non Promotion in the First Grade and Future Progress of Pupils." As reported in *Elementary School Journal* 34:731-2, June, 1934.

185. Doll, Edgar Arnold. "New Thoughts About the Feeble-Minded." *Journal of Educational Research* 8:31-48, June, 1923.

186. "Mental Hygiene Aspects of Special Education." *Proceedings and Addresses of American Association for the Study of the Feebleminded* 35:73-9, 1930.

187. *A Survey and Program for Special Types of Education.* Trenton Board of Education, Trenton, N.J., 1930. 96 pp.

188. Doll, Edgar Arnold; Phelps, Winthrop M.; and Melcher, Ruth Taylor. *Mental Deficiency Due to Birth Injuries.* The Macmillan Co., New York, 1932. 289 pp.

189. Dooley, William Henry. *The Education of the Ne'er-Do-Well.* Houghton Mifflin Co., New York, 1916. 163 pp.

190. Doring, J. "Modern Trends in Activity Unit Teaching for Retarded Children." *Proceedings and Addresses of the American Association for Mental Defectives* 39:90-4, 1934.

191. Douglass, Harl Roy. "Certain Aspects of the Problem of Where We Stand with Reference to the Practicability of Grouping." *Journal of Educational Research* 26:344-53, January, 1933.

192. Douglass, Harl Roy, and Collins, J. H. "A Study of the Relationships of Certain Factors to Failure Among Superior Pupils in a Junior High School for Negroes." *Journal of Negro Education* 5:599-601, 1936.

193. Drake, Richard M. "A Comparison of Two Methods of Teaching High School Algebra." *Journal of Educational Research* 29:12-16, September, 1935.

194. Dresher, Richard. "Training in Mathematics Vocabulary." *Educational Research Bulletin* 13:201-4, November, 1934.

195. Durell, Fletcher. "Ability Grouping in Mathematical Classes." *Mathematics Teacher* 21:398-411, November, 1928.

196. Durling, Dorothy, and Powell, Webster. "Improper School Placement as a Factor in Juvenile Delinquency." *Journal of Applied Psychology* 16:519-24, October, 1932.

197. Dvorak, August, and English, Elsie. "The Efficiency of Remedial Teaching." *Educational Administration and Supervision* 18:466-71, September, 1932.

198. Dvorak, August, and Rae, J. J. "A Comparison of the Achievement of Superior Children in Segregated and Unsegregated First-Grade Classes." *Elementary School Journal* 29:380-6, January, 1929.

199. Eastburn, Lacey Arnold. "Report of Class Size Investigations in the Phoenix Union High School, 1933-34 to 1935-36." *Journal of Educational Research* 21:107-17, October, 1937.

200. Ederer, S. "Das Schwererziehbare Kind als Biologisches Problematisch." *Jahrbuch Kinderheilkeit* 144:11-23, 1935.

201. Edmiston, Robert Wentz. "The Effects of Emphasizing 'How to Learn' upon Knowledge of Course Content and School Marks." *Journal of Educational Psychology* 28:371-81, May, 1937.

202. Eisenson, Jon. *Confirmation and Information in Rewards and Punishments.* Columbia University, Archives of Psychology No. 181, New York, 1935. 37 pp.

203. Eisner, Harry. *The Classroom Teacher's Estimation of Intelligence and Industry of High School Students.* Columbia University, Teachers College, Contributions to Education No. 726, New York, 1937. 108 pp.

204. "The Challenge of the Slow Pupil." *Mathematics Teacher* 32:9-15, January, 1939.

205. Elkind, H. B., and Middleton, H. R. "A Psychiatrist Looks at Remedial Teaching." *Understanding the Child* 7:14-19, 1938.

206. Ellis, Emmett. "Recitation Frequency and Pupil Achievement." *Peabody Journal of Education* 14:80-2, September, 1936.

207. Elwell, J. L., and Grindley, G. C. "The Effect of Knowledge of Results on Learning and Performance." *British Journal of Psychology* 29:39-54, July, 1938.

208. Engle, Anna M. "Characteristic and Significant Differences between X and Z Pupils in the Detroit Public Schools." *Elementary School Journal* 24:747-54, June, 1924.

209. Engle, T. L. "Home Environments and School Records." *School Review* 42:590-8, October, 1934.

210. Englehart, Max D. "The Relative Contribution of Certain Factors to Individual Differences in Arithmetical Problem Solving Ability." *Journal of Experimental Education* 1:19-27, 1932.

211. Evans, (Mrs.) Elida. *The Problem of the Nervous Child.* Dodd, Mead and Co., New York, 1920. 299 pp.

212. Farley, Eugene S. "Regarding Repeaters: Sad Effect of Failures upon the Child." *Nation's Schools* 18:37-9, October, 1936.

213. Farley, Eugene S.; Frey, A. J.; and Garland, Gertrude. "Factors Related to the Grade Progress of Pupils." *Elementary School Journal* 34:186-93, November, 1933.

214. Featherstone, William Bland. *The Curriculum of the Special Class, Its Underlying Principles.* Columbia University, Teachers College, Contributions to Education No. 544, New York, 1932. 157 pp.

215. Feder, Daniel Dunn. "The Effect of Directions and Arrangement of Items on Student Performance in a Test." *Journal of Educational Research* 30:28-35, September, 1936.

216. Feingold, Gustave Alexander. "Fifteen Years of Homogeneous Grouping in the High School." *Educational Administration and Supervision* 20:382-91, May, 1934.

217. "Adjusting the Curriculum to Mental Capacity." *Educational Administration and Supervision* 23:354-66, May, 1937.

218. Fernald, Mabel Ruth. "Problems Related to the Education of Mentally Defective Children." *Elementary School Journal* 28:205-13, November, 1927.

219. Fildes, Raymond E. "Blackboards and Their Use." *Elementary School Journal* 35:760-7, June, 1935.

220. Fisher, Mildred L. "Measured Differences Between Problem and Non-problem Children in a Public-School System." *Journal of Educational Sociology* 7:353-64, February, 1934.

221. Fitzpatrick, Frederick Linder. *Science Interests.* Columbia University Press, New York, 1936. 72 pp.

222. Flewelling, Wilma Shaffer. "A Critical Evaluation of Individualized Instruction in Mathematics." *Mathematics Teacher* 20:280-5, May, 1927.

223. Flory, Charles D., and Webb, James F. "Cumulative Records for Elementary Schools." *Elementary School Journal* 38:278-90, December, 1937.

224. Forlano, George. *School Learning with Various Methods of Practice and Rewards.* Columbia University, Teachers College, Contributions to Education No. 688, New York, 1936. 114 pp.

225. Freeland, George Earl. *Modern Elementary School Practice.* The Macmillan Co., New York, 1919. pp. 278-9, 408 pp.

226. Freeman, F. N., and Flory, C. D. *Growth in Intellectual Ability as Measured by Repeated Tests.* Monographs of the Society for Research in Child Development, Vol. 2, No. 2, 1937. 116 pp.

227. French, John R. P. "A Layman Looks at Mathematics." *Mathematics Teacher* 22:348-60, October, 1929.

228. Fuller, Florence D. "Achievement of Slow Pupils in Arithmetic." *Educational Research Bulletin* (Los Angeles City Schools) 8:2-5, May-June, 1929.

229. Gates, Arthur Irving. "The Problem of Class Size in the Elementary Grades." As reported in the *Elementary School Journal* 37:405-7, February, 1937.

230. Gates, Arthur Irving, and Bond, Guy L. "Some Outcomes of Instruction in the Speyer Experimental School (P. S. 500)." *Teachers College Record* 38:206-17, December, 1936.

231. Gaw, Frances. "Keeping the Normal Child Normal." *National Parent-Teachers Magazine* 30:6-7, 28, 30-1, November, 1935.

232. Gesell, Arnold. *Exceptional Children and Public School Policy Including a Mental Survey of the New Haven Elementary Schools.* Yale University Press, New Haven, 1921. 66 pp.

233. "The Growth Factor in Child Personality." *Bulletin of the Department of Elementary School Principals* 15:254-8, July, 1936.

234. *The Retarded Child: How to Help Him.* Public School Publishing Co., Bloomington, Ill., 1938. 100 pp.

235. Gillett, Norma. "Improving Pupil Attitudes Thru the Personal Conference." *Bulletin of the Department of Elementary School Principals* 15:534-40, July, 1936.

236. Gillett, Norma. "Adjusting the Report Card to Modern Practice." As reported in *Elementary School Journal* 37:650-1, May, 1937.

237. Gilliland, A. R. "The Law of Effect in Learning." *Journal of Comparative Psychology* 24:495-504, December, 1937.

238. Goddard, Henry Herbert. *School Training of Defective Children.* World Book Co., New York, 1914. 97 pp.

239. Good, Warren R. "Opinions on Home Work for Elementary-School Pupils." *Elementary School Journal* 27:116-22, October, 1926.

240. Grady, William E. "Forced Promotions." As reported in *Elementary School Journal* 30:408-9, February, 1930.

241. Gray, Eleanor A. *Syllabus for the Examination and Census of Mentally Retarded, Subnormal, or Atypical Children.* University of the State of New York, Albany, November 1, 1918. 22 pp.

242. *Manual of Suggestions for the Use of the Phonograph in Special Classes.* University of the State of New York, Albany, 1926. 38 pp.

243. Greene, Harry Andrew. "A Critique of Remedial and Drill Materials in Arithmetic." *Journal of Educational Research* 21:262-76, April, 1930.

244. Greene, H. A., and Freden, G. "Failures and Double Promotions in the Elementary School." *Journal of Educational Research* 17:262-72, April, 1928.

245. Greenfield, Samuel C. "Failure in Mathematics: a Problem in Mental Hygiene." *High Points* 17:16-22, December, 1935.

246. Grossnickle, Foster Earl. "An Experiment with a One-Figure Divisor in Short and Long Division." *Elementary School Journal* 34:496-506, March, 1934; 590-9, April, 1934.

247. "To Check or Not to Check?" *Elementary School Journal* 36:35-9, September, 1935.

248. "Transfer of Knowledge of Multiplication Facts to Their Use in Long Division." *Journal of Educational Research* 29:677-85, May, 1936.

249. "The Effectiveness of Checking Subtraction by Addition." *Elementary School Journal* 38:436-41, February, 1938.

250. Groszmann, Maximilian Paul Eugene. *The Exceptional Child.* Charles Scribner's Sons, New York, 1917. 764 pp.

251. Guiler, Walter Scribner. "How Different Mental Tests Agree in Rating Children." *Elementary School Journal* 22:734-44, June, 1922.

252. "Improving Computational Ability." *Elementary School Journal* 30:111-16, October, 1929.

253. "Improvement and Permanency of Learning Resulting from Remedial Instruction." *School Review* 41:450-8, June, 1933.

254. Haggerty, M. E. "The Incidence of Undesirable Behavior in Public-School Children." *Journal of Educational Research* 12:102-22, September, 1925.

255. Hall-Quest, Alfred Lawrence. *Supervised Study: A Discussion of the Study Lesson in High School.* The Macmillan Co., New York, 1916. 433 pp.

256. Hambrick, F. L. "A New Plan for Forming Class Groups." *Elementary School Journal* 34:749-53, June, 1934.

257. Hamilton, Dwight. "An Experiment with an Individual Technique in Sixth Grade Arithmetic." *Journal of Educational Research* 18:339-44, November, 1928.

258. Hanna, Paul Robert. "Methods of Arithmetic Problem Solving." *Mathematics Teacher* 23:442-50, November, 1930.

259. *Arithmetic Problem Solving: A Study of the Relative Effectiveness of Three Methods of Problem Solving.* Columbia University, Teachers College, New York, 1930. 68 pp.

260. Hansen, Lena B. "Creating Interest in Mathematics through Special Topics." *Mathematics Teacher* 23:3-6, January, 1930.

261. Hansen, Rowna. *Some Educational Activities for the Young Child in the Home.* U.S. Office of Education, Pamphlet No. 51, Washington, D.C., 1934. 23 pp.

262. Harap, Henry, and Mapes, Charlotte E. "The Learning of Fundamentals in an Arithmetic Activity Program." *Elementary School Journal* 34:515-25, March, 1934.

263. "The Learning of Decimals in an Arithmetic Activity Program." *Journal of Educational Research* 29:686-93, May, 1936.

264. Hardy, Martha Crumpton. "Improvement in Educational Achievement Accompanying a Health Education Program." *Journal of Educational Research* 30: 110-23, 1936.

265. Hardy, Martha Crumpton, and Hoefer, Carolyn H. *Healthy Growth: A Study of the Influence of Health Education on Growth and Development of School Children.* University of Chicago Press, Chicago, 1936. 360 pp.

266. Harlan, Charles L. "Size of Class and Types of Instruction." *Journal of Educational Research* 14:120-5, 1926.

267. Hassler, Jasper Ole. "The Use of Mathematical History in Teaching." *Mathematics Teacher* 22:166-71, March, 1929.

268. Hattwick, (Mrs.) LaBerta Weiss, and Stowell, Margaret. "The Relation of Parental Over-Attentiveness to Children's Work Habits and Social Adjustments in Kindergarten and the First Six Grades of School." *Journal of Educational Research* 30:169-76, November, 1936.

269. Hawley, W. E., and Pechstein, Louis Augustus. "Diminishing Returns in Reducing Non-Promotion." *Elementary School Journal* 22:584-96, April, 1922.

270. Hawver, Marguerite Newell. *A Study of the Progress Made in Arithmetic in One School Year by a Group of Twenty Retarded Pupils.* Ohio State University, Unpublished Master's thesis, Columbus, 1934. 45 pp.

271. Heck, Arch Oliver. *Administration of Pupil Personnel: A Book on Pupil-Accounting Written from the Point of View of the Classroom Teacher.* Ginn and Co., Boston, 1929. 479 pp.

272. *Special Schools and Classes in Cities of 10,000 Population in the United States, 1927-28.* U.S. Office of Education, Bulletin No. 7, Washington, D.C., 1930.

273. Heckert, John Walter. "The Cleveland Survey Tests in Arithmetic in the Miami Valley." *Elementary School Journal* 18:447-57, February, 1918.

274. "The Effects of Supervised Study in English Composition." *Journal of Educational Research* 5:368-80, May, 1922.

275. Hedrick, Earl Raymond. "Teaching for Transfer of Training in Mathematics." *Mathematics Teacher* 30:51-5, February, 1937.

276. Hildreth, Gertrude. "A Survey of Problem Pupils." *Journal of Educational Research* 18:1-14, June, 1928.

277. "Number Readiness and Progress in Arithmetic." *Journal of Experimental Education* 4:1-6, September, 1935.

278. "Skills in the Modern School Program." *Childhood Education* 15:197-201, January, 1939.

279. Hill, David Spence. "Remaining Errors in Measures of Retardation." *Elementary School Journal* 19:700-12, May, 1919.

280. Hilleboe, Guy Leonard. *Finding and Teaching Atypical Children.* Columbia University, Teachers College, Contributions to Education No. 423, New York, 1930. 177 pp.

281. Hoag, Ruth. "Sources of Program Materials and Some Types of Program Work Which Might Be Undertaken by High School Mathematics Clubs." *Mathematics Teacher* 24:492-502, December, 1931.

282. Hoefer, Carolyn H., and Hardy, M. C. "The Rôle of Health in the Child's Development." *Elementary School Journal* 35:423-39, February, 1935.

283. Hollingshead, Arthur Dack. *An Evaluation of the Use of Certain Educational and Mental Measurements for Purposes of Classification.* Columbia University, Teachers College, New York, 1928. 63 pp.

284. Hollingworth, (Mrs.) Leta Stetter. *The Psychology of Subnormal Children.* The Macmillan Co., New York, 1920. 288 pp.

285. Holmes, Arthur. *The Conservation of the Child: A Manual of Clinical Psychology, Presenting the Examination and Treatment of Backward Children.* J. B. Lippincott Co., Philadelphia, 1912. 345 pp.

286. *Backward Children.* Bobbs-Merrill Co., Indianapolis, 1915. 247 pp.

287. Holmes, Hilda M. "The Motivation of Primary Work." *Elementary School Journal* 20:767-71, June, 1920.

288. Holroyd, Ina M. "Weaknesses of High School Students Who Enter College Mathematics and a Suggested Remedy." *Mathematics Teacher* 27:128-37, March, 1934.

289. Holzinger, Karl J. "Periodical Literature on Supervised Study During the Last Five Years." *Elementary School Journal* 20:146-54, October, 1919.

290. Hooper, Laura. "What About School Failures?" *Elementary School Journal* 36:349-53, January, 1936.

291. Hoover, J. H. "Motivated Drill Work in Third-Grade Arithmetic and Silent Reading." *Journal of Educational Research* 4:200-11, October, 1921.

292. Horn, John Lewis. *The Education of Exceptional Children.* The Century Co., New York, 1924. 377 pp.

293. "Special Education of Dull Normal Children." *Educational Research Bulletin* (Los Angeles City Schools), March, 1928.

294. Hughes, Charles C. "The Abolition of Home Study." As reported in *School Review* 24:231-2, March, 1916.

295. Hull, Evelyn. "A Project in the Social Application of Arithmetic." *Elementary School Journal* 24:673-8, May, 1924.

296. Hull, J. D. "Making School Marks More Meaningful." *Education Digest* 4:30-1, April, 1939.

297. Hutchinson, J. B., and Pugh, B. M. "A Note on the Importance of the Differences between Examiners in the Estimation of the Ability of Students." *Ann. Eugen. Camb.* 8:107-16, 1938.

298. Immaculata, Sister Mary. *Permanence of Improvement and the Distribution of Learning in Addition and Subtraction.* Catholic University of America, Education Research Bulletin, Vol. 5, Nos. 9, 10, Washington D.C., 1930. 81 pp.

299. Ingram, Christine Porter. *Education of the Slow-Learning Child.* World Book Co., New York, 1935. 419 pp.

300. Inskeep, A. D. *Teaching Dull and Retarded Children.* The Macmillan Co., New York, 1926. 455 pp.

301. Irmina, Sister Mary. *The Relative Merits of Methods of Subtraction.* Catholic University of America, Education Research Bulletin, Vol. 3, No. 9, Washington, D.C., November, 1928. 29 pp.

302. Irving, George Russell. "Fatigue in Children." *Elementary School Journal* 28:193-201, November, 1927.

303. Jalota, S. S. "Errors in the Learning of Elementary Arithmetic." *Indiana Journal of Psychology* 10:111-18, 1935.

304. James, Haddon W. "Punishments Recommended for School Offenses: A Rebuttal." *Elementary School Journal* 30:300-6, December, 1929.

305. Jenkins, J. G. "Instruction as a Factor in 'Incidental' Learning." *American Journal of Psychology* 45:471-7, July, 1933.

306. Jennings, Rosalie. "Keeping Store—A Project in Arithmetic." *School and Community* 21:111-12, March, 1935.

307. Jensen, Milton B., and Jensen, (Mrs.) Dortha W. "The Influence of Class Size upon Pupil Accomplishment in High-School Algebra." *Journal of Educational Research* 21:120-37, February, 1930; 337-56, May, 1930.

308. Jersild, Arthur Thomas, and Holmes, Frances. *Children's Fears.* Columbia University, Child Development Monographs No. 20, New York, 1935. 356 pp.

309. John, Lenore. "Difficulties in Solving Problems in Arithmetic." *Elementary School Journal* 31:202-15, November, 1930.

310. Johnson, John Theodore. "The Merits of Different Methods of Subtraction." *Journal of Educational Research* 10:279-90, November, 1924.

311. "Adapting Instructional Material to Individual Differences in Learning." *Mathematics Teacher* 26:193-9, April, 1933.

312. "Curriculum Revision in Elementary Mathematics in Chicago." *Mathematics Teacher* 31:322-5, November, 1938.

313. *The Relative Merits of Three Methods of Subtraction; an Experimental Comparison of the Decomposition Method of Subtraction with the Equal Additions Method and the Austrian Method.* Columbia University, Teachers College, Contributions to Education No. 738, New York, 1938. 76 pp.

314. Johnson, Palmer Oliver. "The Differential Functions of Examinations." *Journal of Educational Research* 30:93-103, October, 1936.

315. Johnson, William Harding. "The New Arithmetic Course in the Chicago Elementary Schools." *Mathematics Teacher* 31:126-8, March, 1938.

316. "Individualized Methods of Learning." *Chicago Schools Journal* 20:201-8, May, 1939.

317. Jones, Harold Ellis; Conrad, H. S.; and Blanchard, M. B. "Environmental Handicap in Mental Test Performance." *University of California Publications in Psychology*, Vol. 5, No. 3, University of California Press, Berkeley, 1932. pp. 63-99.

318. Jones, Robinson Godfrey, and Buckley, H. M. *The Bazaar as a School Activity; a Description of an Arithmetic Bazaar Held at Gordon School Curriculum Center for Arithmetic.* Board of Education, Cleveland, Ohio, 1929. 128 pp.

319. Jordan, Arthur Melville. *Educational Psychology.* Henry Holt and Co., New York, 1928. 460 pp.

320. Judd, Charles Hubbard. *Psychology of High-School Subjects.* Ginn and Co., New York, 1915. 515 pp.

321. "Informational Mathematics Versus Computational Mathematics." *Mathematics Teacher* 22:187-96, April, 1929.

322. Kallom, Arthur W. "Analysis of and Testing in Common Fractions." *Journal of Educational Research* 1:177-92, March, 1920.

323. Kanner, Leo. "Problem Children Growing Up." *American Journal of Psychiatry* 94:691-9, November, 1937.

324. Kaufmann, Myrtle L. "Systematizing Drill." As reported in *Elementary School Journal* 22:251-2, December, 1921.

325. Keator, Maud. "Mental Age Versus Chronological Age as a Basis for Admission to the First Grade." As reported in *Elementary School Journal* 30:653-4, May, 1930.

326. Keener, Edward E. "Results of Homogeneous Classification of Junior High-School Pupils." *Journal of Educational Research* 14:14-20, June, 1926.

327. "What Size Class?" *Elementary School Journal* 32:144-6, October, 1931.

328. Kefauver, Grayson N. "The Validity of Bases for Forming Ability Groups." *Teachers College Record* 31:99-114, November, 1929.

329. Keister, Mary E., and Updegraff, Ruth. "A Study of Children's Reactions to Failure and an Experimental Attempt to Modify Them." *Child Development* 8:241-8, September, 1937.

330. Keith, Allen P. "Continuous-Progress Promotion Plan in New Bedford, Massachusetts." As reported in *Elementary School Journal* 38:168-9, November, 1937.

331. Keliher, Alice Virginia. *A Critical Study of Homogeneous Grouping with a Critique of Measurement as the Basis for Classification.* Columbia University, Teachers College, Contributions to Education No. 452, New York, 1931. 165 pp.

332. Kelly, W. A. "The Unsocial Problem Child." *Catholic School Interests* 15:105-7, 1937.

333. Kennedy-Fraser, David. *Education of the Backward Child.* D. Appleton-Century Co., New York, 1932. 236 pp.

334. Kessler, R. V. "Mathematics Teams to Motivate Drill Work in Junior High Schools." *Mathematics Teacher* 27:25-9, January, 1934.

335. Keyes, Charles Henry. *Progress Through the Grades of City Schools: A Study of Acceleration and Arrest.* Columbia University, Teachers College, Contributions to Education No. 42, New York, 1911. 79 pp.

336. Keys, Noel. "The Influence of Learning and Retention of Weekly as Opposed to Monthly Tests." *Journal of Educational Psychology* 25:427-36, September, 1934.

337. Kirby, Thomas Joseph. *Practice in the Case of School Children.* Columbia University, Teachers College, Contributions to Education No. 58, New York, 1913. 98 pp.

338. Kirkendall, Lester Allen. "The Influence of Certain Incentives in the Motivation of Children." *Elementary School Journal* 38:417-24, February, 1938.

339. Kirkpatrick, James Earl. "The Motivating Effect of a Specific Type of Testing Program." *University of Iowa Studies in Education,* Vol. 9, No. 4, Iowa City, Iowa, 1934. pp. 41-68.

340. Klapper, Paul. *The Teaching of Arithmetic.* D. Appleton-Century Co., New York, 1934. 525 pp.

341. Klene, Vivian, and Branson, Ernest P. "Trial Promotion versus Failure." *Educational Research Bulletin* (Los Angeles City Schools) 8:6-11, January, 1929.

342. Knight, F. B. "An Analysis of Multiplication Drill." *Journal of Educational Research* 8:199-207, October, 1923.

343. "The Superiority of Distributed Practice in Drill in Arithmetic." *Journal of Educational Research* 15:157-65, March, 1927.

344. Knight, Frederic Butterfield, and Ford, E. "Temporary Lapses in Ability and Error in Arithmetic." *Elementary School Journal* 32:111-24, October, 1931.

345. Knox, Margaret. "The School, the Maladjusted Child, and the Visiting Teacher." *Elementary School Journal* 28:176-80, November, 1927.

346. "The Visiting Teacher and the Problem Child." *Bulletin of the Department of Elementary School Principals* 9:467-71, April, 1930.

347. Koch, Helen Lois. "Some Factors Affecting the Relative Efficiency of Certain Modes of Presenting Material for Memorizing." *American Journal of Psychology* 42:370-88, July, 1930.

348. Kramer, Grace Amanda. *The Effect of Certain Factors in the Verbal Arithmetic Problem upon Children's Success in the Solution.* Johns Hopkins University, Studies in Education No. 20, Baltimore, 1933. 106 pp.

349. Krathwohl, William Charles. "Helping Mathematics with an Exhibit." *Mathematics Teacher* 31:68-9, February, 1938.

350. Krueger, William C. F. "The Effect of Overlearning on Retention." *Journal of Experimental Psychology* 12:71-8, February, 1929.

351. Kuhlmann, Frederick. "The Larger Aspects of the Special Class." *Journal of Juvenile Research* 13:19-27, 1929.

352. Kulp, Claude L. "A Method of Securing Real-Life Problems in the Fundamentals of Arithmetic." *Elementary School Journal* 29:428-30, February, 1929.

353. Kulp, Daniel Harrison. "The Role of Purpose in Achievement." *Journal of Applied Psychology* 19:478-89, August, 1935.

354. Kvaraceus, William C., and Wiles, M. E. "An Experiment in Grouping for Effective Learning." *Elementary School Journal* 39:264-8, December, 1938.

355. Kyte, George Cleveland. "Causes of First-Grade Non-Promotion in the Light of Measured Intelligence." *Elementary School Journal* 37:415-28, February, 1937.

356. La Brant, Lou Le Vanche. "The Fallacy of 'Modified Courses.'" *Educational Research Bulletin* 15:141-3, May 13, 1936.

357. Laird, Louise. "Teaching a Retarded Group." *Journal of Education* 121:227-8, October, 1938.

358. Lamson, Edna Emma. "To What Extent Are Intelligence Quotients Increased by Children Who Participate in a Rich Vital School Curriculum?" *Journal of Educational Psychology* 29:67-70, 1938.

359. Landell, Catherine. "Why Ignore the Problem of the Subnormal Child?" *American School Board Journal* 91:24, August, 1935.

360. Lane, Howard A., and Witty, P. A. "The Educational Attainment of Delinquent Boys." *Journal of Educational Psychology* 25:695-702, December, 1934.

361. Langlie, Theos Alvin. "Personality Ratings: I. Reliability of Teachers' Ratings." *Journal of Genetic Psychology* 50:339-59, June, 1937.

362. Laselle, Mary Augusta. "Causes of the Success or the Failure of First-Year Boys in a Vocational School." *Elementary School Journal* 18:369-76, January, 1918.

363. Laugier, H., and Weinberg, D. "Le Facteur Subjective dans les Notes d'Examen." *Journal de Psychologie* 29:463-5, 1932.

364. Lee, Dorris May, and Lee, J. Murray. "Maintenance Drills in the Junior High School." *Mathematics Teacher* 24:448-52, November, 1931.

365. Lessenger, W. E. "Reading Difficulties in Arithmetical Computation." *Journal of Educational Research* 11:287-91, April, 1925.

366. Lewin, K. "The Psychological Situation Attending Reward and Punishment." *Shr. Psychol. Pedag.* 1:31-76, 1933.

367. Lincoln, Edward Andrews. "Ability Grouping in Theory and Practice." *School and Society* 30:447-53, October 5, 1929.

368. Lincoln, Edward Andrews, and Wadleigh, Verna L. "Teacher Opinion on Ability Grouping." *Journal of Educational Research* 21:277-82, April, 1930.

369. "Ability Grouping at Reading, Massachusetts." *School and Society* 31:746-9, May 31, 1930.

370. Lindsay, James Armour. *Annual and Semi-Annual Promotion with Special Reference to the Elementary School.* Columbia University, Teachers College, Contributions to Education No. 570, New York, 1933. 170 pp.

371. Lochhead, Jewell. "The Play Way; Material to Stimulate Interest in Reading and Numbers." *The Grade Teacher* 52:30ff, January, 1935.

372. Lockwood, L. A. "Causes of Tardiness." *School Review* 38:538-43, September, 1930.

373. Lockwood, Margaret M. "Character Education Practices." *Educational Method* 15:361-5, April, 1936.

374. Lord, Arthur B. "A Survey of Four Hundred Forty-nine Special Class Pupils." *Journal of Educational Research* 27:108-14, October, 1933.

375. Lorge, Irving. "The Efficacy of Intensified Reward and of Intensified Punishment." *Journal of Experimental Psychology* 16:177-207, April, 1933.

376. McAfee, Lucius. "Effect of Various Incentives on Improvement in Addition." As reported in *Elementary School Journal* 22:253, December, 1921.

377. McAndrew, William. "Trial Promotions." As reported in *Elementary School Journal* 27:162-4, November, 1926.

378. McCall, William Anderson. *How to Measure in Education.* The Macmillan Co., New York, 1922. 416 pp.

379. McClure, W. E. "Problem Children." As reported in *Elementary School Journal* 29:655-6, May, 1929.

380. McCullough, Ashley Melvin. "The Opportunities of Pupils to Participate in the Teacher's Time." *Elementary School Journal* 28:538-43, March, 1928.

381. MacDowall, Margaret. *Simple Beginnings in the Training of Mentally Defective Children.* Local Government Press Co., London, 1921. 129 pp.

382. McElwee, Edna Willis. "A Comparison of the Personality Traits of 300 Accelerated, Normal, and Retarded Children." *Journal of Educational Research* 26:31-4, September, 1932.

383. "A Study of Mechanical Ability and Homogeneous Grouping." *Journal of Juvenile Research* 16:304-9, October, 1932.

384. "Homogeneous Grouping of Retarded Pupils." *Elementary School Journal* 34:118-21, October, 1933.

385. McFarland, Blanche Bulifant. "A Plea for Arithmetic in the First Grade." *The Kindergarten and the First Grade* 7:1-7, January; 49-55, February; 92-8, March; 137-42, April; 180-5, May, 1922.

386. McGaughy, J. R. "Homogeneous Grouping of Pupils." *Childhood Education* 6:291-6, March, 1930.

387. McLaughlin, Katherine L., and Troxell, Eleanor. *Number Projects for Beginners.* J. B. Lippincott Co., Philadelphia, 1923. 110 pp.

388. MacLeod, Kenneth M. "Comparison of Three Types of Organization in the First and Second Grades." *Educational Method* 12:354-9, March, 1933.

389. Maclin, Gladys May. "Differentiation of Courses of Study in Denver for Slow-Learning Children." *Elementary School Journal* 30:104-10, October, 1929.

390. McNair, George Hastings. *Methods of Teaching Modern Day Arithmetic.* Gorham Press, Boston, 1923. 419 pp.

391. McPherson, G. E. "Special Classes for Retarded Children." *Proceedings and Addresses of the American Association for Mental Defectives* 38:202-9, 1933.

392. McQuilkin, De Grange. "Statisticians, Dull Children, and Psychologists." *Educational Administration and Supervision* 17:561-73, November, 1931.

393. MacTaggart, M. M. "Non Scholastic Tests for Backward Children." *Forum of Education* 2:102-12, 1927.

394. Madison, Hazel. "Rummage Sale." *Wisconsin Journal of Education* 67:267-8, February, 1935.

395. Maller, Julius Bernard. *Co-operation and Competition; An Experimental Study in Motivation.* Columbia University, Teachers College, Contributions to Education No. 384, New York, 1929. 176 pp.

396. Mallory, Virgil Sampson. "Mathematics for the Slow-Moving Pupil." *Mathematics Teacher* 26:391-8, November, 1933.

397. "Activity in Mathematics—The Slow-Moving Pupil." *Mathematics Teacher* 29:23-6, January, 1936.

398. "Providing for Individual Needs in Mathematics." *Mathematics Teacher* 30:214-20, May, 1937.

399. Martens, E. H. "A Conference on Curriculum for Mentally Retarded Children." *Proceedings of the American Association for Mental Defectives* 40:35-43, 1935.

400. Martin, A. Leila, and Pechstein, L. A. "Educational Tests for Retarded School Children." *Journal of Educational Research* 9:403-10, May, 1924.

401. Mateer, Florence. *The Unstable Child; An Interpretation of Psychopathy as a Source of Unbalanced Behavior in Abnormal and Troublesome Children. A Practical Manual for Teachers and Students.* D. Appleton-Century Co., New York, 1924. 471 pp.

402. *Mathematics for Elementary Schools—A Handbook for Teachers.* University of the State of New York, Albany, 1937.

403. Matthews, Nora A. "Education of Pupils in Special Classes." *Bulletin of the Department of Elementary School Principals* 9:298-306, April, 1930.

404. Maurer, Harold R. "Informal Pupil-Home Reports." As reported in *Elementary School Journal* 38:323-4, January, 1938.

405. Mayberry, L. W. "Individualizing Problems for Pupils." *Elementary School Journal* 18:133-7, October, 1917.

406. Mecker, Herman H. "An Experiment in the Adjustment of Retarded Upper-Grade Pupils." *Bulletin of the Department of Elementary School Principals* 15:162-5, April, 1936.

407. Meek, Lois Hayden. "The Relation of Family and School Life in the Education of Children." *Teachers College Record* 36:271-8, January, 1935.

408. "Behavior Problems in the School." *Teachers College Record* 37:300-4 January, 1936.

409. Meeks, Anna R. "Recreational Aspects of Mathematics in the Junior High School." *Mathematics Teacher* 29:20-2, January, 1936.

410. Meier, Clara. "Effect of Prizes in Increasing the Word Learning of Subnormal Children." *Training School Bulletin* 32:146-57, December, 1935.

411. Mellinger, Bonnie Eugenie. *Children's Interests in Pictures.* Columbia University, Teachers College, Contributions to Education No. 516, New York, 1932. 52 pp.

412. Meng, H. "Strafen und Erziehen." *Zeitschrift Psychoanal. Pädag.* 9:293-300, 1935.

413. Mensenkamp, L. E. "Ability Classification in Ninth Grade Algebra." *Mathematics Teacher* 22:38-47, January, 1929.

414. Merrill, Maud Amanda. *On the Relation of Intelligence to Achievement in the Case of Mentally Retarded Children.* Williams and Wilkins Co., Baltimore, 1924. 100 pp.

415. Metzner, Alice B., and Berry, Charles Scott. "Size of Class for Mentally Retarded Children." *Training School Bulletin* 23:241-51, October, 1926.

416. Miller, Harry Lloyd. *Directing Study; Educating for Mastery Through Creative Thinking.* Charles Scribner's Sons, New York, 1922. 377 pp.

417. Miller, Henry Willard. "Profits Derived from Segregating College Students on the Basis of Ability." *Science* 65:427-9, April 29, 1927.

418. Miller, William Allen. "The Picture Choices of Primary-Grade Children." *Elementary School Journal* 37:273-82, December, 1936.

419. Miller, W. S., and Otto, Henry J. "Analysis of Experimental Studies in Homogeneous Grouping." *Journal of Educational Research* 21:95-102, February, 1930.

420. Minnick, J. H. "An Experiment in the Supervised Study of Mathematics." *School Review* 21:670-5, December, 1913.

421. Minor, Ruby. "Project-Teaching in Grade Six." *Elementary School Journal* 20:137-45, October, 1919.

422. Mitchell, Claude. "The Specific Type of Problem in Arithmetic versus the General Type of Problem." *Elementary School Journal* 29:594-6, April, 1929.

423. "Problem Analysis and Problem-Solving in Arithmetic." *Elementary School Journal* 32:464-6, February, 1932.

424. Mitchell, David. "Schools and Classes for Exceptional Children." In *The Cleveland School Survey* (Summary Volume), by Leonard P. Ayres, Ch. 10, pp. 203-18. The Survey Committee of the Cleveland Foundation, Cleveland, Ohio, 1917.

425. Moe, George A. "How to Correlate Mathematics and History." *Minnesota Journal of Education* 15:144-5, December, 1934.

426. Moles, Maude E. "Summary of Address by Dr. J. C. Brown on Principal Causes of Failure among Mathematics Teachers." *Bulletin of the Kansas Association of Teachers of Mathematics* 10:3-4, April, 1936.

427. Monroe, Walter Scott. "A Series of Diagnostic Tests in Arithmetic." *Elementary School Journal* 19:585-607, April, 1919.

428. *How Pupils Solve Problems in Arithmetic.* University of Illinois, College of Education, Bureau of Educational Research, Bulletin No. 44, Urbana, 1929. 31 pp.

429. "Hazards in the Measurement of Achievement." *School and Society* 41:48-52, January 12, 1935.

430. Moore, Eoline Wallace. "Travel Motivates Mathematics; a Unit Based upon Foreign Exchange." *Mathematics Teacher* 29:27-8, January, 1936.

431. Moose, Carleton A. "A Critical Evaluation of Review." *School Science and Mathematics* 34:528-31, May, 1934.

432. Morgan, (Mrs.) Barbara Spafford. *The Backward Child; a Study of the Psychology and Treatment of Backwardness.* G. P. Putnam's Sons, New York, 1914. 263 pp.

433. Morrison, Henry Clinton. *The Practice of Teaching in the Secondary School.* University of Chicago Press, Chicago, 1926. 661 pp.

434. Morrison, John Cayce. "Methods of Improving Classroom Instruction Used by Helping-Teachers and Supervising-Principals of New Jersey." *Elementary School Journal* 20:208-16, November, 1919.

435. "Can We Adapt Arithmetic Instruction to the Needs of All the Children?" *Mathematics Teacher* 31:373-8, December, 1938.

436. Morrison, John Cayce; Cornell, W. B.; and Coxe, W. W. *Survey of the Need for Special Schools and Classes in Westchester County, New York.* University of the State of New York, Albany, 1924. 29 pp.

437. Mort, Paul R. "Administrative and Supervisory Policies Facilitating Pupil Adjustment." *Bulletin of the Department of Elementary School Principals* 15:330-9, July, 1936.

438. Morton, Robert Lee. "An Analysis of Pupils' Errors in Fractions." *Journal of Educational Research* 9:117-25, February, 1924.

439. "Pupils' Errors in Solving Arithmetic Problems." *Educational Research Bulletin* 4:155-8, April 15, 1925.

440. *Teaching Arithmetic in the Primary Grades.* Silver, Burdett and Co., New York, 1927. 242 pp.

441. *Teaching Arithmetic in the Intermediate Grades.* Silver, Burdett and Co., New York, 1927. 358 pp.

442. "Developing Number Ideas." *Grade Teacher* 49:770, 813, June, 1932.

443. Moulton, E. J. "Teaching Mathematics." *National Mathematics Magazine* 10:175, February, 1936.

444. Murphy, Clara Della. "An Attempt at Solving the Problem of Individual Differences." *Mathematics Teacher* 29:32-9, January, 1936.

445. Myers, Garry Cleveland. "Some Variabilities and Correlations in Learning." *American Journal of Psychology* 29:316, July, 1918.

446. "Lost in Concrete Instances—Many Learners." *Journal of Educational Research* 5:135-8, February, 1922.

447. *The Prevention and Correction of Errors in Arithmetic.* The Plymouth Press, Chicago, 1925. 76 pp.

448. "Schoolroom Hazards to the Mental Health of Children." *Mental Hygiene* 12:18-24, January, 1928.

449. Myers, Garry Cleveland, and Myers, Caroline C. "The Cost of Quick Shifting in Number Learning." *Educational Research Bulletin* (Ohio State University) 7:327-34, October 31, 1928.

450. Myers, G. W. "The Threefold Objective of Drill in Arithmetic." *School Science and Mathematics* 28:281-9, March, 1928.

451. Neal, Elma A.; and Foster, Inez. "An Experiment with Remedial Work in Common Fractions." *Elementary School Journal* 29:280-3, December, 1928.

452. Nemzek, Claude L. "The Value of Amount of Tardiness and Absence for Direct and Differential Prediction of Academic Success." *Journal of Experimental Education* 7:4-10, September, 1938.

453. Neulen, Leon Nelson. *Problem-Solving in Arithmetic; a Study of Certain Factors in the Allocation of Arithmetic Problems Involving One, Two, Three and Four Steps or Processes in Reasoning.* Columbia University, Teachers College, Contributions to Education No. 483, New York, 1931. 87 pp.

454. Newcomb, R. S. "Teaching Pupils How to Solve Problems in Arithmetic." *Elementary School Journal* 23:183-9, November, 1922.

455. Newland, T. E. *Chart for Diagnosis of Illegibilities in Written Arabic Numerals.* Public School Publishing Co., Bloomington, Ill., 1931.

456. New York City, Superintendent of Schools. "Retardation and Promotion in the Schools of New York City." As reported in *Elementary School Journal* 30:90-1, October, 1929.

457. New York Times. "The Visiting Teacher." As reported in *Elementary School Journal* 20:165-6, November, 1919.

458. Norsworthy, Naomi. *The Psychology of Mentally Deficient Children.* Science Press, New York, 1906. 111 pp.

459. Noyes, Dorothy. "Finding Social Mathematics in School Activities." *Mathematics Teacher* 29:340-5, July, 1936.

460. Nudd, Howard W. "The Purpose and Scope of Visiting Teacher Work." In *The Problem Child in School; Narratives from Case Records of Visiting Teachers,* by Mary Buell Sayles, pp. 253-80. Joint Committee on Methods of Preventing Delinquency, New York, 1925.

461. Nyberg, Joseph Antonius. "Remedial Classes in Geometry." *School Science and Mathematics* 34:853-61, November, 1934.

462. Olander, Herbert Theodore, and Sharp, E. Preston. "Long Division versus Short Division." *Journal of Educational Research* 26:6-11, September, 1932.

463. Olander, Herbert Theodore, and Walker, B. S. "Can Teachers Estimate I.Q.'s?" *School and Society* 44:744-6, December 5, 1936.

464. Oppenheimer, Julius John. *The Visiting Teacher Movement, With Special Reference to Administrative Relationships.* Public Education Association of the City of New York, New York, 1925. 203 pp.

465. Orata, Pedro Tamesis. "Transfer of Training and Educational Pseudo-Science." *Mathematics Teacher* 28:265-89, May, 1935.

466. "Transfer of Training and Reconstruction of Experience." *Mathematics Teacher* 30:99-109, March, 1937.

467. O'Reilly, E. P. "Preventing Maladjustment by Providing for Individual Differences." *Bulletin of the Department of Elementary School Principals* 15:340-7, July, 1936.

468. *Organization of Special Classes for Subnormal Children.* University of the State of New York, Albany, January 15, 1930. 9 pp.

469. Osborne, Raymond W., and Gillet, H. O. "Mental Age Is Important Factor in Teaching Arithmetic." *Nation's Schools* 12:19-24, July, 1933.

470. Osburn, Worth James. *Education in Wisconsin.* State Department of Public Instruction, Madison, Wisconsin, 1920-22.

471. *Corrective Arithmetic for Supervisors, Teachers, and Teacher Training Classes,* Vol. 1. Houghton Mifflin Co., Boston, 1924. 182 pp.

472. "Arithmetic More than a Knowledge of Number." As reported in *Elementary School Journal* 26:170-2, November, 1925.

473. *Corrective Arithmetic for Supervisors, Teachers, and Teacher-Training Classes,* Vol. 2. Houghton Mifflin Co., Boston, 1929. 279 pp.

474. O'Shea, William J. "Teaching the Art of Study." *Elementary School Journal* 28:242-8, December, 1927.

475. Otis, Arthur Sinton. "Ability Grouping." *School and Society* 36:116-18, July 23, 1932.

476. Otto, Henry J. "Remedial Instruction in Arithmetic." *Elementary School Journal* 28:124-33, October, 1927.

477. "Administrative Control of Pupil Promotion in Elementary Schools." *Educational Trends* 2:28-33, January, 1933.

478. "Implications for Administration and Teaching Growing out of Pupil Failures in First Grade." *Elementary School Journal* 33:25-32, September, 1933.

479. "Pupil Failure as an Administrative Device in Elementary Education." *Elementary School Journal* 34:576-89, April, 1934.

480. *Promotion Policies and Practices in Elementary Schools.* Educational Test Bureau, Educational Monographs No. 5, Minneapolis, 1935. 171 pp.

481. Otto, Henry John, and Melby, E. O. "An Attempt to Evaluate the Threat of Failure as a Factor in Achievement." *Elementary School Journal* 35:588-96, April, 1935.

482. Overman, James Robert. *Principles and Methods of Teaching Arithmetic.* Lyons and Carnahan, Chicago, 1925. 342 pp

483. "An Experimental Study of the Effect of the Method of Instruction on Transfer of Training in Arithmetic." *Elementary School Journal* 31:183-90, November, 1930.

484. Palmer, Katherine Ball. "Mathematics in the Home." *Mathematics Teacher* 24:353-63, October, 1931.

485. Panlasigui, Isidora, and Knight, Frederic Butterfield. "The Effect of Awareness of Success or Failure." In *Report of the Society's Committee on Arithmetic, Twenty-ninth Yearbook of the National Society for the Study of Education*, pp. 611-19. Public School Publishing Co., Bloomington, Ill., 1930.

486. Parker, Samuel Chester. "Adapting Instruction to Differences in Capacity." *Elementary School Journal* 25:20-30, September, 1924.

487. Partridge, Clara Martin. "Number Needs in Children's Reading Activities." *Elementary School Journal* 26:357-66, January, 1926.

488. Patri, Angelo. "Backward Children." *Training School Bulletin* 31:1-5, March, 1934.

489. Patton, L. M. "Studying Differences among School Children." *Bulletin of the Department of Elementary School Principals* 9:444-53, April, 1930.

490. Paynter, Richard H., and Blanchard, Phyllis. *A Study of Educational Achievement of Problem Children.* The Commonwealth Fund, Division of Publications, New York, 1929. 72 pp.

491. Pennsylvania Department of Public Instruction. *Organization and Administration of Special Education Classes for the Orthogenic Backward.* The Commonwealth of Pennsylvania Department of Public Instruction, Bulletin No. 85, Harrisburg, 1935. 91 pp.

492. Perl, Ruth Eastwood. *The Effect of Practice Upon Individual Differences.* Columbia University, Archives of Psychology No. 159, New York, 1934. 54 pp.

493. Pertsch, C. Frederick. *A Comparative Study of the Progress of Subnormal Pupils in the Grades and in Special Classes.* C. F. Pertsch, Public School No. 29, New York, 1936. 102 pp.

494. Pessin, Joseph. "The Comparative Effects of Social and Mechanical Stimulation on Memorizing." *American Journal of Psychology* 45:263-70 April, 1933.

495. Peterson, A. M., and Doll, E. A. "Sensory Discrimination in Normal and Feeble-Minded Children." *Training School Bulletin*, Vol. 11, Nos. 7-8, 1914.

496. Peterson, Harvey Andrew; Ellis, Mary; Toohill, Norine; and Kloess, Pearl. "Some Measurements of the Effects of Reviews." *Journal of Educational Psychology* 26:65-72, January, 1935.

497. Phelps, C. L. "A Study of Errors in Tests of Adding Ability." *Elementary School Teacher* 14:29-39, September, 1913.

498. Pintner, Rudolf, and Noble, Helen. "The Classification of School Children According to Mental Age." *Journal of Educational Research* 2:713-28, November, 1920.

499. Postel, Harold H. "The Effect of Adapting Reading Materials to Seriously Retarded Pupils." *Elementary School Journal* 37:536-40, March, 1937.

500. Poull, Louise E. "The Effect of Improvement in Nutrition on the Mental Capacity of Young Children." *Child Development* 9:123-6, March, 1938.

501. Powell, Jesse Jerome. *A Study of Problem Material in High School Algebra.* Columbia University, Teachers College, Contributions to Education No. 405, New York, 1929. 100 pp.

502. Pratt, Carroll C. "Repetition, Motivation, and Recall." *British Journal of Psychology* 26:425-9, April, 1936.

503. Pratt, George Kenneth. *Mental Hygiene and the Individual Child.* University of Iowa, Child Welfare Pamphlet No. 20, Iowa City, July 22, 1933. 10 pp.

504. Prendergast, Ella M. "Mathematics and Social Science." *Mathematics Teacher* 26:33-9, January, 1933.

505. Pressey, Luella Cole, and Elam, M. K. "The Fundamental Vocabulary of Elementary School Arithmetic." *Elementary School Journal* 33:46-50, September, 1932.

506. Pressey, Luella Cole, and Moore, W. S. "The Growth of Mathematical Vocabulary from the Third Grade through High School." *School Review* 40:449-54, June, 1932.

507. Preston, George H. "The Teacher Sets Her House in Order." *Childhood Education* 12:11-17, October, 1935.

508. Price, E. D. "A Plan of Classifying Pupils." *Journal of Educational Research* 12:341-8, December, 1925.

509. Pullias, Earl V. *Variability in Results from New-Type Achievement Tests.* Duke University, Durham, N.C., 1937. 100 pp.

510. Purdom, Thomas Luther. *The Value of Homogeneous Grouping.* Warwick and York, Inc., University Research Monographs No. 1, Baltimore, 1929. 99 pp.

511. Pyle, William Henry, and Snadden, G. H. "An Experimental Study of Bright and Dull High School Pupils." *Journal of Educational Psychology* 20:262-79, April, 1929.

512. Ramseyer, John A. "The Mathematics Laboratory—A Device for Vitalizing Mathematics." *Mathematics Teacher* 28:228-33, April, 1935.

513. Rankin, Paul T. "Pupil Classification and Grouping." *Review of Educational Research* 1:200-30, June, 1931.

514. Rankin, William Walter. "The Cultural Value of Mathematics." *Mathematics Teacher* 22:215-23, April, 1929.

515. Reavis, W. C. "The Social Motive in the Teaching of Arithmetic." *Elementary School Journal* 18:264-7, December, 1917.

516. Reeve, William David. "Mathematics and the Integrated Program in Secondary Schools." *Teachers College Record* 36:497-507, March, 1935.

517. "Research in Mathematics Education." *Mathematics Teacher* 29:6-9, January, 1936.

518. Regensberg, Jeanette. *Studies of Educational Success and Failure in Supernormal Children.* Columbia University, Archives of Psychology No. 129, New York, 1931. 150 pp.

519. Reid, Florence E. "Incidental Number Situations in First Grade." *Journal of Educational Research* 30:36-43, September, 1936.

520. Renwick, E. M. "Children's Misconceptions Concerning the Symbols for Mathematical Equality." *British Journal of Educational Psychology* 2:173-83, June, 1932.

521. *The Case Against Arithmetic.* Simpkin Marshall, London, 1935. 167 pp.

522. Rice, Joseph M. "Test in Arithmetic." *Forum* 34:281-97, October, 1902.

523. "Causes of Success and Failure in Arithmetic." *Forum* 34:437-52, January, 1903.

524. Rich, Frank Merritt. "Project Arithmetic, Numeration to 100 and the Tables." *American Childhood* 20:9-10, January, 1935.

525. "Making Arithmetic Tables Visual." *American Childhood* 20:10-11, 45, March, 1935.

526. Ridenour, Nina A. "A Study of the Backgrounds of Withdrawing Children." *Journal of Educational Research* 28:132-43, October, 1934.

527. Risen, Maurice L. "Relation of Lack of One or Both Parents to School Progress." *Elementary School Journal* 39:528-31, March, 1939.

528. Riter, Harold E. "The Enrichment of the Mathematics Course." *Mathematics Teacher* 31:3-6, January, 1938.

529. Rivlin, Harry Nathaniel. *Educating for Adjustment: The Classroom Applications of Mental Hygiene.* D. Appleton-Century Co., New York, 1936. 419 pp.

530. Roantree, William F., and Taylor, Mary S. *An Arithmetic for Teachers.* The Macmillan Co., New York, 1926. 621 pp.

531. Roberts, Carolyn. "The Home-Planning Arithmetic." *Elementary School Journal* 22:621-4, April, 1922.

532. Roberts, Lydia Jane. "Malnutrition, the School's Problem." *Elementary School Journal* 22:457-67, February, 1922.

533. "How a Teacher Can Judge the Nutrition of School Children." *Elementary School Journal* 29:189-97, November, 1928.

534. Robinson, Arthur E. "Are We Teaching Arithmetic Effectively? A Summary of a Recent Study." *Mathematics Teacher* 28:215-22, April, 1935.

535. Rogers, Charles Fletcher. "Arithmetic and Emotional Difficulties in Some University Students." *Mathematics Teacher* 30:3-9, January, 1937.

536. Rogers, Don Clifford. "A Study of Pupil Failures in Chicago." *Elementary School Journal* 26:273-7, December, 1925.

537. Rogers, James Frederick. *What Every Teacher Should Know about the Physical Condition of Her Pupils.* U.S. Office of Education, Pamphlet No. 68, Washington, D.C., 1936. 30 pp.

538. Rugg, Harold Ordway, and Schumaker, Ann. *The Child-Centered School; an Appraisal of the New Education.* World Book Co., New York, 1928. 359 pp.

539. Russell, F. O., and Long, Irma B. "A Comparison of Two Methods of Instruction in Seventh-Grade Mathematics." *University of Kansas, Bulletin of Education* 2:21-4, December, 1929.

540. Russell, Ned M. "Arithmetical Concepts of Children." *Journal of Educational Research* 29:647-63, May, 1936.

541. St. John, Charles Webster. "The Maladjustment of Boys in Certain Elementary Grades." *Educational Administration and Supervision* 18:659-72, December, 1932.

542. Salkind, Charles. "A Geometry Class Examines the Constitution." *High Points* 19:44-7, January, 1937.

543. Sand, Harold J. "An Evaluation of the Effects of Marks as Incentives to Pupil Growth in Spelling Ability and of the Comparative Values of Equated Scales and Informal Tests as Measurements of the Progress." *Journal of Educational Research* 31:678-82, May, 1938.

544. Sanford, Vera. "Extraneous Details." *Mathematics Teacher* 21:83-91, February, 1928.

545. Sangren, Paul V. "The Woody-McCall Mixed Fundamentals Tests and Arithmetical Diagnosis." *Elementary School Journal* 24:206-15, November, 1923.

546. Sayles, Mary Buell. *The Problem Child in School; Narratives from Case Records of Visiting Teachers.* Joint Committee on Methods of Preventing Delinquency, New York, 1925. 287 pp.

547. Scarf, Robert C. "Special Disability in Reading and Arithmetic." *Twentieth Annual Conference on Educational Measurements.* Indiana University, Bulletin of the School of Education, Vol. 10, No. 1, Bloomington, December, 1933. pp. 70-84.

548. Scates, Douglas Edgar. "The Essential Conditions of Measurement." *Psychometrika* 2:27-34, March, 1937.

549. Schaeffer, Grace C. "An Informational Unit on Time." *Elementary School Journal* 38:114-17, October, 1937.

550. Scheidemann, Norma Valentine. *The Psychology of Exceptional Children.* Houghton Mifflin Co., Boston, 1931. 520 pp.

551. Schleier, Louis M. *Problems in the Training of Certain Special-Class Teachers.* Columbia University, Teachers College, Contributions to Education No. 475, New York, 1931. 138 pp.

552. Schlotte, Felix. "Ausschuss fur Begabungsuntersuchung von Haupt und Sonderklassenschüleren" *Padagogisch-Psychologische Arbeiten aus dem Institut des Leipziger Lehrervereins* 18:7-48, 1930.

553. Schmidt, T. "Der Rechenunterricht im Ersten Hilfsschuljahr und Seine Psychologische Grundlage." *Hilfsschule* 22:705-13, 1929.

554. Schmitt, Clara. "Extreme Retardation in Arithmetic." *Elementary School Journal* 21:529-47, March, 1921.

555. Schnell, Leroy H. "A Redefinition of Secondary School Mathematics." *Mathematics Teacher* 29:14-19, January, 1936.

556. Schorling, Raleigh. "The Need for Being Definite with Respect to Achievement Standards." *Mathematics Teacher* 24:311-29, May, 1931.

557. Schorling, Raleigh, Chairman. "Report of the Committee on Individual Differences." *Mathematics Teacher* 26:350-65, October, 1933.

558. Scouse, J. B. "The Difficulty of the Concrete." *School Science and Mathematics* 37:937-45, November, 1937.

559. Sinclair, Samuel Bower. *Backward and Brilliant Children.* Ryerson Press, Toronto, 1931. 75 pp.

560. Skinner, Charles E., Editor. *Educational Psychology.* Prentice-Hall, Inc., New York, 1936. 754 pp.

561. Small, Jennie A. "The Beginning of Formal Number Work." *Elementary School Journal* 18:357-68, January, 1918.

562. Smerling, Frank A. "What the Schools as Constituted at Present Can Do for the Low Ability Pupil." *High Points* 18:35-8, June, 1936.

563. Smith, Elsie Wardley. "Mental Confusion in Arithmetic." *Forum of Education* 7:211-26, November, 1929.

564. Smith, Ethel E., and Burton, W. H. "The Effect upon Pupil Achievement in Arithmetic Reasoning and Arithmetic Computation of a Supervisory Program Emphasizing Computation." *Educational Method* 12:267-71, February, 1933.

565. Smith, Grace. "Home Work or Supervised Study?" *Mathematics Teacher* 23:489-91, December, 1930.

566. Smith, Helen Raymond. *The Difficult Child and the Teacher.* Book Co., Calcutta, 1934. 193 pp.

567. Smith, James H. "Arithmetical Combinations." *Elementary School Journal* 21:762-70, June, 1921.

568. Smith, Nila Banton. "An Investigation of the Uses of Arithmetic in the Out-of-school Life of First Grade Children." *Elementary School Journal* 24:621-6, April, 1924.

569. "The Key-Teacher Scheme of Supervision." *Elementary School Journal* 28:576-86, April, 1928.

570. Soth, M. R. "A Study of a Pupil Retarded in Arithmetic." *Elementary School Journal* 29:439-42, February, 1929.

571. South Carolina State Department of Education. "Retardation in the First Grade." As reported in *Elementary School Journal* 34:88-91, October, 1933.

572. Springer, N. Norton. "The Influence of General Social Status on School Children's Behavior." *Journal of Educational Research* 32:583-91, April, 1939.

573. Stalnaker, Elizabeth M., and Roller, R. D., Jr. "A Study of One Hundred Non-Promoted Children." *Journal of Educational Research* 16:265-70, November, 1927.

574. Stedman, Melissa Branson. "The Influence of Health upon Intelligence and School Grades of High School Pupils." *Journal of Applied Psychology* 18:799-809, December, 1934.

575. Steinbach, Alexander Alan. "A Survey of Adjustment Difficulties in Children and Youth Drawn from the Normal Population." *Elementary School Journal* 34:122-9, October, 1933.

576. Steiner, Melvin Arthur. "Value of Home-Study Assignments." *School and Society* 40:20-4, July 7, 1934.

577. Stenquist, J. L. "The Administration of a Program of Diagnosis and Remedial Instruction." *Yearbook of the National Society for the Study of Education* 34 (Pt. I): 501-23, 1935.

578. Stevens, B. A. "Problem Solving in Arithmetic." *Journal of Educational Research* 25:253-60, April, 1932.

579. Stevenson, George Salvadore. *Organizing for a Child Guidance Clinic.* The Commonwealth Fund, Division of Publications, New York, 1930. 16 pp.

580. Stevenson, George Salvadore, and Smith, Geddes. *Child Guidance Clinics, A Quarter Century of Development.* The Commonwealth Fund, Division of Publications, New York, 1934. 186 pp.

581. Stevenson, Paul Raymond. *Smaller Classes or Larger; a Study of the Relation of Class-Size to the Efficiency of Teaching.* Public School Publishing Co., Journal of Educational Research Monographs No. 4, Bloomington, Ill., 1923. 127 pp.

582. *Class-Size in the Elementary School.* Ohio State University, Bureau of Educational Research, Monograph No. 3 (University Studies, Vol. 2, No. 10), 1925. 35 pp. As reported in *Elementary School Journal* 26:487-8, March, 1926.

583. Stoddard, George Dinsmore. *The Exceptional Child, the Dull, the Bright, and Specially Talented.* University of Iowa, Child Welfare Pamphlets No. 8, Iowa City, 1932. 7 pp.

584. *Intelligence Testing.* University of Iowa, Child Welfare Pamphlets No. 9, Iowa City, 1932. 8 pp.

585. Stone, John Charles. *How to Teach Primary Number: A Course of Study and a Manual for Teachers.* B. H. Sanborn and Co., Chicago, 1922. 174 pp.

586. Stout, Humbert G. "Variations of Normal Children." *Journal of Experimental Education* 6:84-100, September, 1937.

587. Street, Roy Frink. "Factors Related to Maladjustment in School." *Elementary School Journal* 34:676-80, May, 1934.

588. Streitz, Ruth. *Provisions for Exceptional Children in 191 Illinois Cities.* Urbana, Ill., June 4, 1923. 13 pp.

589. Stretch, Lorena Byrd. "The Value and Limitations of Drill in Arithmetic." *Childhood Education* 11:413-16, June, 1935.

590. Stullken, Edward Henry. "A New Departure in the Education of Truant Children." *Education Digest* 4:56-8, September, 1938.

591. Suckow. "Die Zahl im Gesamterlebnis des Kindes und Ihre Loslösung aus Ganzheitlichen Bindungen durch Geeignete Anschauungsmittel." *Hilfsschule* 22:666-8, 1929.

592. Sueltz, Ben A. "Arithmetic Readiness and Curriculum Construction." *Mathematics Teacher* 30:290-2, October, 1937.

593. Sutcliffe, Arthur, and Canham, J. W. "Mental Fatigue and a Longer School Day." *British Journal of Educational Psychology* 6:274-90, November, 1936.

594. Symonds, Percival Mallon. *Mental Hygiene of the School Child.* The Macmillan Co., New York, 1934. 321 pp.

595. (Symposium.) "Teaching the Complete Duffer." (The Report of the [British] Mathematical Association) *Mathematical Gazette* 22:164-79, May, 1938.

596. Tate, Harry L. "An Evaluation of the Project Method." *Elementary School Journal* 37:122-32, October, 1936.

597. Taylor, Joseph S. "Omitting Arithmetic in the First Year." *Educational Administration and Supervision* 2:87-93, February, 1916.

598. Taylor, Katherine. "The Learning Process." *Bulletin of the Kansas Association of Teachers of Mathematics* 62 (Pt. II):3, December, 1937. Also in *Atlantic Monthly* 160:496-502, October, 1937.

599. Terman, Lewis M., and DeVoss, James C. "The Educational Achievements of Gifted Children." *Yearbook of the National Society for the Study of Education* 23:169-84, 1924.

600. Terry, Paul Washington *How Numerals Are Read: An Experimental Study of the Reading of Isolated Numerals and Numerals in Arithmetic Problems.* University of Chicago Press, Supplementary Educational Monographs No. 18, Chicago, 1922. 109 pp.

601. Theisen, W. W. "The Relative Progress of 7-B Groups Sectioned on the Basis of Ability." *Journal of Educational Research* 5:295-305, April, 1922.

602. Thompson, Jeannie B. *The Art of Teaching Arithmetic.* Longmans, Green and Co., New York, 1928. 295 pp.

603. Thomson, Edith I. M. "A Study of the Efficiency of 'Individual Work.'" *British Journal of Educational Psychology* 2:257-75, November, 1932.

604. Thorndike, Edward Lee. *The New Methods in Arithmetic.* Rand McNally and Co., Chicago, 1921. 260 pp.

605. Thorpe, Louis Peter. "Danger Signals of Needed Pupil Adjustment." *School and Society* 46:799-801, December 18, 1937.

606. Tiegs, Ernest Walter. "The I.Q. and Individual Guidance." *Educational Scene* 3:152-4, April, 1938. Also in *Educational Digest* 3:28-9, June, 1938.

607. Tilton, John Warren. "The Feasibility of Ability Grouping." *Journal of Educational Research* 28:30-5, September, 1934.

608. Torgerson, T. L. "Is Classification by Mental Ages and Intelligence Quotients Worth While?" *Journal of Educational Research* 13:171-80, March, 1926.

609. *The Diagnosis and Treatment of Pupil Maladjustment: Part B, Case Study Record.* E. M. Hale Co., Milwaukee, 1938.

610. Truitt, Ralph P., *et al. The Child Guidance Clinic and the Community.* The Commonwealth Fund, Division of Publications, New York, 1928. 102 pp.

611. Trustram, Sidney F. "That Dull Subject, Mathematics." *Mathematical Gazette* 22:250-4, July, 1938.

612. Tso, J. H. "An Experimental Study of a Curve of Mental Fatigue." *Educational Review* (Chinese) 26:137-46, 1936.

613. Tucker, Louise Emery. *A Study of Problem Pupils.* Columbia University, Teachers College, Contributions to Education No. 720, New York, 1937. 172 pp.

614. Turner, Claude F. "Motivating Junior High School Mathematics." As reported in *Elementary School Journal* 36:731-2, June, 1936.

615. "What Need for Mathematics in Grade VIII?" *School Review* 45:592-601, October, 1937.

616. Turner, Perley S. "Problems of the Dull-Normal Group at the Secondary School Level." *School and Society* 50:485-91, October 14, 1939.

617. Tyler, R. W. "Elements of Diagnosis." *Yearbook of the National Society for the Study of Education* 34:113-29, 1935.

618. Uger, Charles. "The Relationship of Teachers' Attitudes to Children's Problem Behavior." *School and Society* 47:246-8, February 19, 1938.

619. Uhl, Willis Lemon. "The Use of Standardized Materials in Arithmetic for Diagnosing Pupils' Methods of Work." *Elementary School Journal* 18:215-18, November, 1917.

620. "Some Neglected Aspects of Educational Measurement." *Journal of Educational Research* 27:241-6, December, 1933.

621. U.S. Bureau of Education. "Classification of Pupils According to Ability." As reported in *Elementary School Journal* 27:488-9, March, 1927.

622. Upton, Clifford B. *First Days with Numbers.* American Book Co., New York, 1933. 160 pp.

623. VanAlstyne, Dorothy. "A Study of Ten Gifted Children Whose School Progress Was Unsatisfactory." *Journal of Educational Research* 8:122-35, September, 1923.

624. Van Wagenen, M. J. "The Effect of Homogeneous Grouping upon the Quality of Work of Superior Children." *Journal of Educational Method* 6:240-7, February, 1927.

625. Varner, G. F. "Can Teachers Select Bright and Dull Pupils?" *Journal of Educational Research* 6:126-32, September, 1922.

626. Vasey. "Care of Pupils Below Normal." As reported in *Elementary School Journal* 21:328-9, January, 1921.

627. Wahlstrom, Ebba L. "The Computational Arithmetic of Social Experiences of Third Grade Children." *Journal of Educational Research* 30:124-9, 1936.

628. Walcott, Fred G. "New Methods and Objectives in Teaching Dull-Normal Pupils to Read." *School Review* 44:348-61, May, 1936.

629. Walker, Wilma. *The Visiting Teacher.* University of Iowa, Child Welfare Pamphlets No. 19, Iowa City, 1933. 11 pp.

630. Wallenstein, Nehemiah. *Character and Personality of Children from Broken Homes.* Columbia University, Teachers College, Contributions to Education No. 721, New York, 1937. 86 pp.

631. Wallin, John Edward Wallace. *The Mental Health of the School Child, the Psycho-Educational Clinic in Relation to Child Welfare; Contributions to a New Science of Orthophrenics and Orthosomatics.* Yale University Press, New Haven, Conn., 1914. 463 pp.

632. *The Achievement of Subnormal Children in Standardized Tests.* Miami University Bulletin, Series XX, No. 7, Oxford, Ohio, 1922. 98 pp.

633. *Studies of Mental Defects and Handicaps.* Miami University Bulletin, Oxford, Ohio, January, 1924. 177 pp.

634. *The Education of Handicapped Children.* Houghton Mifflin Co., Boston, 1924. 394 pp.

635. "Admission Procedures and Standards for Classes for Mentally Deficient and Backward Children." *Elementary School Journal* 31:438-45, February, 1931.

636. *Personality Maladjustments and Mental Hygiene; a Textbook for Psychologists, Educators, Counselors, and Mental Hygiene Workers.* McGraw-Hill Book Co., New York, 1935. 511 pp.

637. "Trends and Needs in the Training of Teachers for Special Classes for Handicapped Children." *Journal of Educational Research* 31:506-26, March, 1938.

638. Walsh, E. A. "Desirable Extensions in the Educational Program for Retarded Children." *Proceedings and Addresses of the American Association for Mental Defectives* 29:81-7, 1934.

639. Warden, C. J., and Cohen, A. "A Study of Certain Incentives Applied under Schoolroom Conditions." *Journal of Genetic Psychology* 39:320-7, September, 1931.

640. Warner, M. La Vinia. "Meeting the Problem of Special Children." *Journal of Abnormal and Social Psychology* 26:405-8, January, March, 1932.

641. Warren, Dorothy E., and Burton, W. H. "Knowledge of Simple Business Practices Possessed by Intermediate-Grade Pupils." *Elementary School Journal* 35:511-16, March, 1935.

642. Washburn, Margaret Floy. "Mathematical Ability, Reasoning, and Academic Standing." *American Journal of Psychology* 50:484-8, 1937.

643. Washburne, Carleton W. "The Individual System in Winnetka." *Elementary School Journal* 21:52-68, September, 1920.

644. "Educational Measurement as a Key to Individual Instruction and Promotions." *Journal of Educational Research* 5:195-206, March, 1922.

645. "Data on Ability Grouping from Winnetka." *Yearbook of the National Society for the Study of Education* 24 (Pt. II):151-4, 1925.

646. "Social Practices in Arithmetic Fundamentals." *Elementary School Journal* 27:60-6, September, 1926.

647. "Comparison of Two Methods of Teaching Pupils to Apply the Mechanics of Arithmetic to the Solution of Problems." *Elementary School Journal* 27:758-67, June, 1927.

648. "Mental Age and the Arithmetic Curriculum: A Summary of the Committee of Seven Grade Placement Investigations to Date." *Journal of Educational Research* 23:210-31, March, 1931.

649. "Functional Arithmetic." *Educational Method* 16:167-70, January, 1937.

650. "Fit the Course of Study to the Child." *National Parent-Teacher* 31:4-5, 21-2, August, 1937.

651. Washburne, Carleton Wolsey, and Morphett, Mabel Vogel. "Unfamiliar Situations as a Difficulty in Solving Arithmetic Problems." *Journal of Educational Research* 18:220-4, October, 1928.

652. Washburne, Carleton Wolsey, and Osborne, Raymond. "Solving Arithmetic Problems." *Elementary School Journal* 27:219-26, November, 1926; 296-304, December, 1926.

653. Washburne, Carleton Wolsey, and Vogel, Mabel. "Are Any Number Combinations Inherently Difficult?" *Journal of Educational Research* 17:235-55, April, 1928.

654. Washburne, C.; Vogel, M.; and Gray, W. S. *A Survey of the Winnetka Public Schools.* Journal of Educational Research, Supplementary Educational Monograph. Public School Publishing Co., Bloomington, Ill., 1926. 136 pp. As reported under the title of "An Evaluation of the Winnetka Plan of Individual Instruction," *in Elementary School Journal* 27:323-5, January, 1927.

655. Weimar, Pauline. "Organization of Our School." *Proceedings of the American Association for the Study of the Feeble Minded* 37:420-34, 1932.

656. Weiner, Meyer. "From Interest to Interest." *Mathematics Teacher* 30:23-6, January, 1937.

657. Weissman, H. "Grouping in Geometry Classes." *Mathematics Teacher* 22:93-108, February, 1929.

658. Wentland, C. R. "Visualizing Percentage Problems." *Wisconsin Journal of Education* 67:173-4, December, 1934.

659. Wenzl, A. "Zur Frage Specifischer Begabung fur Schulleistungen in der Mathematik." *Arb. a. d. Psych. Insitit. d. Munchen* II, 1932.

660. West, Guy A. "The Skills Involved in Problem Solving in Elementary School Arithmetic." *Mathematics Teacher* 23:379-81, October, 1930.

661. West, P. *A Study of Ability Grouping in the Elementary School in Terms of Variability of Achievement, the Teaching Problem, and Pupil Adjustment.* Columbia University, Teachers College, Contributions to Education No. 588, New York, 1933. 70 pp.

662. Wheat, Harry Grove. *The Relative Merits of Conventional and Imaginative Types of Problems in Arithmetic.* Columbia University, Teachers College, Contributions to Education No. 359, New York, 1929. 123 pp.

663. *The Psychology and Teaching of Arithmetic.* D. C. Heath and Co., Boston, 1937. 591 pp.

664. Wheat, Leonard B. "The Flexible Progress Group System." *Elementary School Journal* 38:175-83, November, 1937.

665. Wheeler, E. "Backwardness in Arithmetic." *Report of the British Association for the Advancement of Science* 95:372, 1927.

666. Wheeler, Lester R. "A Study of the Mental Growth of Dull Children." *Journal of Educational Psychology* 21:367-78, May, 1930.

667. Whipple, Guy Montrose. "Experiments in Teaching Students How to Study." *Journal of Educational Research* 19:1-11, January, 1929.

668. Whipple, (Mrs.) Helen Davis. *Making Citizens of the Mentally Limited; a Curriculum for the Special Class.* Public School Publishing Co., Bloomington, Ill., 1927. 374 pp.

669. Whitcraft, L. H. "Remedial Work in High School Mathematics." *Mathematics Teacher* 23:36-51, January, 1930.

670. White, Helen M. "Does Experience in the Situation Involved Affect the Solving of a Problem?" *Education* 54:451-5, April, 1934.

671. White House Conference on Child Health and Protection. *Organization for the Care of Handicapped Children.* The Century Co., New York, 1932. 365 pp.

672. Williams, Claude L., and Whitaker, Ruth L. "Diagnosis of Arithmetic Difficulties." *Elementary School Journal* 37:592-600, April, 1934.

673. Wilson, Dorothy. "Mathematics and Home Economics." *The School* (Toronto, Canada) 22:418-23, January, 1934.

674. Wilson, Estaline. "Improving the Ability to Read Arithmetic Problems." *Elementary School Journal* 22:380-6, January, 1922.

675. Wilson, Frank Thompson. *Learning of Bright and Dull Children.* Columbia University, Teachers College, Contributions to Education No. 292, New York, 1928. 56 pp.

676. "The Effect of the Form of a Combination in the Learning of a Multiplication Table by Bright and Dull Children." *Journal of Educational Psychology* 22:536-7, October, 1931.

677. "Correlations of Vocabulary Knowledge with Other Abilities and Traits in Grade I." *Elementary School Journal* 37:451-7, February, 1937.

678. Wilson, Guy Mitchell. *A Survey of the Social and Business Usage of Arithmetic.* Columbia University, Teachers College, Contributions to Education No. 100, New York, 1919. 62 pp.

679. *What Arithmetic Shall We Teach?* Houghton Mifflin Co., Boston, 1926. 148 pp.

680. "New Standards in Arithmetic." *Journal of Educational Research* 22:351-60, December, 1930.

681. "For 100 Percent Subtraction, What Method? A New Approach." *Journal of Educational Research* 27:503-8, March, 1934.

682. "What Research Reveals on Proper Drill Content of Elementary Arithmetic." *Mathematics Teacher* 28:477-81, December, 1935.

683. "Corrective Load in the Fundamentals of Arithmetic in Grades VI, VII, and VIII." In *The Role of Research in Educational Progress,* pp. 234-41. (Official Report of the American Educational Research Association.) American Educational Research Association of the National Education Association, Washington, D.C., 1937.

684. Wilson, Guy Mitchell, and Dalrymple, C. O. "Useful Fractions." *Journal of Educational Research* 30:341-7, January, 1937.

685. Wilson, Guy Mitchell, and Porter, Everett R. "In the Useful Fundamentals of Arithmetic Is It Possible to Overcome Temporary Lapses in Ability Leading to Steady Increases in Error?" *Journal of Experimental Education* 5:71-4, September, 1936.

686. Wilson, Ruth. "A Unique Mathematics Exhibit." *Mathematics Teacher* 30:128-9, March, 1937.

687. Wise, Carl T. "A Survey of Arithmetical Problems Arising in Various Occupations." *Elementary School Journal* 20:118-36, October, 1919.

688. Witmer, Lightner. *The Special Class for Backward Children; an Educational Experiment Conducted for the Instruction of Teachers and Other Students of Child Welfare.* The Psychological Clinic Press, Philadelphia, 1911. 275 pp.

689. Witty, Paul A. "Special Class Curricula for the Retarded." *Illinois Teacher* 24:132-4, 158, January, 1936.

690. Witty, Paul A., and Beaman, F. N. "Practices in Special Classes." *Educational Trends* 1:4-15, 1932.

691. Woodrow, Herbert Hollingsworth. *Brightness and Dullness in Children.* J. B. Lippincott Co., Philadelphia, 1919. 322 pp.

692. Woody, Clifford. "Types of Arithmetic Needed in Certain Types of Salesmanship." *Elementary School Journal* 22:505-20, March, 1922.

693. "The Arithmetical Backgrounds of Young Children." *Journal of Educational Research* 24:188-201, October, 1931.

694. "An Analysis of Differences in the Learning of Bright and Dull Children." *University of Michigan School of Education Bulletin* 8:37-9, December, 1936. Also in *Education Digest* 2:11-13, February, 1937.

695. "When Shall Systematic Instruction in Arithmetic Begin?" *Educational Method* 16:165-6, January, 1937.

696. "A General Educator Looks at Arithmetic Readiness." *Mathematics Teacher* 30:314-21, November, 1937.

697. Woody, Clifford, *et al.* "A Symposium on the Effects of Measurement on Instruction." *Journal of Educational Research* 28:481-527, March, 1935.

698. Worlton, J. T. "The Why of Homogeneous Classification." *Elementary School Journal* 27:265-74, December, 1926.

699. "The Effect of Homogeneous Classification on the Scholastic Achievement of Bright Pupils." *Elementary School Journal* 28:336-45, January, 1928.

700. "Shall We Eliminate the Comparative Marking System from the Report Card?" *Elementary School Journal* 33:176-84, November, 1932.

701. Wrinkle, William Lawrence. "Mathematics in the Modern Curriculum for Secondary Education." *Mathematics Teacher* 29:374-80, December, 1936.

702. Young, Florence M. "Causes for Loss of Interest in High-School Subjects as Reported by 651 College Students." *Journal of Educational Research* 25:110-15, February, 1932.

703. Young, Meredith. *The Mentally Defective Child; Written Specially for School Teachers and Others Interested in the Educational Treatment and After-Care of Mentally Defective School Children.* Paul B. Hoeber, New York, 1916. 140 pp.

704. Zachry, Caroline Beaumont. *Personality Adjustments of School Children.* Charles Scribner's Sons, New York, 1929. 306 pp.

705. Zirkle, H. W. "Character and Results of Special Rooms as Conducted in the Whittier School." *Elementary School Journal* 21:189-97, November, 1920.

706. Zornow, Theodore A., and Pechstein, Louis Augustus. "An Experiment in the Classification of First-Grade Children Through the Use of Mental Tests." *Elementary School Journal* 23:136-46, October, 1922.

707. Zubin, Joseph. *Some Effects of Incentives; a Study of Individual Differences in Rivalry.* Columbia University, Teachers College, Contributions to Education No. 532, New York, 1932. 60 pp.

INDEX TO BIBLIOGRAPHY

Causes of Success and Failure, and Sources of Error (General)

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Investigation of Nursing as a Professional Opportunity for Girls, Part I, Technical Study; Part II, Vocational Information Bulletin. By Florence E. Blazier. Vol. I, No. 2, 1924. 69 p.

Proceedings of the Eleventh Conference on Educational Measurements. Vol. I, No. 3, 1925. 141 p.

Proceedings of the High School Principals' Conference (November 14 and 15, 1924). Vol. I, No. 4, 1925. 49 p. (Supply exhausted.)

First Revision of the Bibliography of Educational Measurements. Compiled by the Bureau of Cooperative Research. Vol. I, No. 5, 1925. 147 p. (Supply exhausted.)

Proceedings of the Twelfth Conference on Educational Measurements. Vol. I, No. 6, 1925. 76 p.

The Effect of Population upon Ability to Support Education. By Harold F. Clark. Vol. II, No. 1, 1925. 28 p.

Proceedings of the High School Principals' Conference (November 20 and 21, 1925). Vol. II, No. 2, 1925. 77 p. (Supply exhausted.)

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Proceedings of the Thirteenth Annual Conference on Educational Measurements. Vol. II, No. 5, 1926. 103 p.

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Index Numbers in School Administration. By Harold F. Clark. Vol. III, No. 3, 1927. 35 p.

Topical Analysis of 23½ School Surveys. Compiled by the Bureau of Cooperative Research. Vol. III, No. 4, 1927. 111 p. (Supply exhausted.)

Proceedings of the Fourth Annual Conference on Elementary Supervision. Vol. III, No. 5, 1927. 64 p.

Proceedings of the Fourteenth Annual Conference on Educational Measurements. Vol. III, No. 6, 1927. 66 p.

Some Phases of the Junior College Movement. By I. Owen Foster, Harold F. Clark, Willard W. Patty, and Leo M. Chamberlain. Vol. IV, No. 1, 1927. 125 p. (Supply exhausted.)

Second Revision of the Bibliography of Educational Measurements. By Henry Lester Smith and Wendell William Wright. Vol. IV, No. 2, 1927. 251 p. (75¢)

Bibliography of School Buildings, Grounds, and Equipment, Part I. By Henry Lester Smith and Leo Martin Chamberlain. Vol. IV, No. 3, 1928. 326 p. (75¢)

Proceedings of the High School Principals' Conference (November 18 and 19, 1927). Vol. IV, No. 4, 1928. 54 p.

The Economic Effects of Education. By Harold F. Clark. Vol. IV, No. 5, 1928. 39 p.

Proceedings of the Fifteenth Annual Conference on Educational Measurements. Vol. IV, No. 6, 1928. 73 p.

Proceedings of the Fifth Annual Conference on Elementary Supervision. Vol. V, No. 1, 1928. 54 p.

Proceedings of the High School Principals' Conference (November 16 and 17, 1928). Vol. V, No. 2, 1928. 33 p.

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Tentative Program for Teaching World Friendship and Understanding in Teacher Training Institutions and in Public Schools for Children Who Range from Six to Fourteen Years of Age. By Henry Lester Smith and Sherman Gideon Crayton. Vol. V, No. 5, 1929. 54 p.

Proceedings of the Sixteenth Annual Conference on Educational Measurements. Vol. V, No. 6, 1929. 96 p.

Proceedings of the Sixth Annual Conference on Elementary Supervision. Vol. VI, No. 1, 1929. 73 p.

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Proceedings of the High School Principals' Conference (November 22 and 23, 1929). Vol. VI, No. 3, 1930. 51 p.

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Proceedings of the Seventeenth Annual Conference on Educational Measurements. Vol. VI, No. 5, 1930. 103 p.

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Proceedings of the High School Principals' Conference (November 7 and 8, 1930). Vol. VII, No. 2, 1930. 70 p.

The Philosophy of Human Relations: Individual and Collective—A Source Book. By Henry Lester Smith and Harold Littell. Vol. VII, No. 3, 1931. 326 p. (75¢)

The Psychology of Human Relationships: Individual and Social—A Source Book. By Henry Lester Smith and Levi McKinley Krueger. Vol. VII, No. 4, 1931. 107 p.

Proceedings of the Eighteenth Annual Conference on Educational Measurements. Vol. VII, No. 5, 1931. 83 p.

Efficiency in College Management. By John Dale Russell. Vol. VII, No. 6, 1931. 143 p.

Bibliography of School Surveys and of References on School Surveys. By Henry Lester Smith and Edgar Alvin O'Dell. Vol. VIII, Nos. 1 and 2, 1931. 212 p. (75¢)

Proceedings of the Nineteenth Annual Conference on Educational Measurements. Vol. IX, No. 1, 1932. 139 p.

Bibliography of School Buildings, Grounds, and Equipment—Part II. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. IX, No. 2, 1933. 182 p.

Bibliography of School Buildings, Grounds, and Equipment—Part III. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. IX, No. 3, 1933. 130 p.

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Proceedings of the Twentieth Annual Conference on Educational Measurements. Vol. X, No. 1, 1933. 98 p.

Bibliography of College and University Buildings, Grounds, and Equipment. By Henry Lester Smith and Forest Ruby Noffsinger. Vol. X, No. 2, 1934. 199 p. (75¢)

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